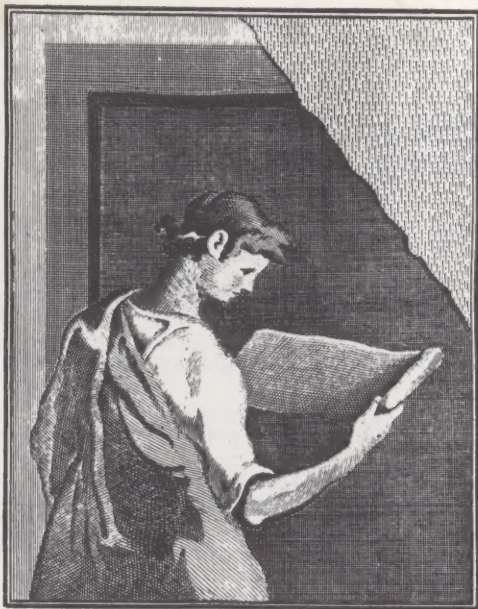


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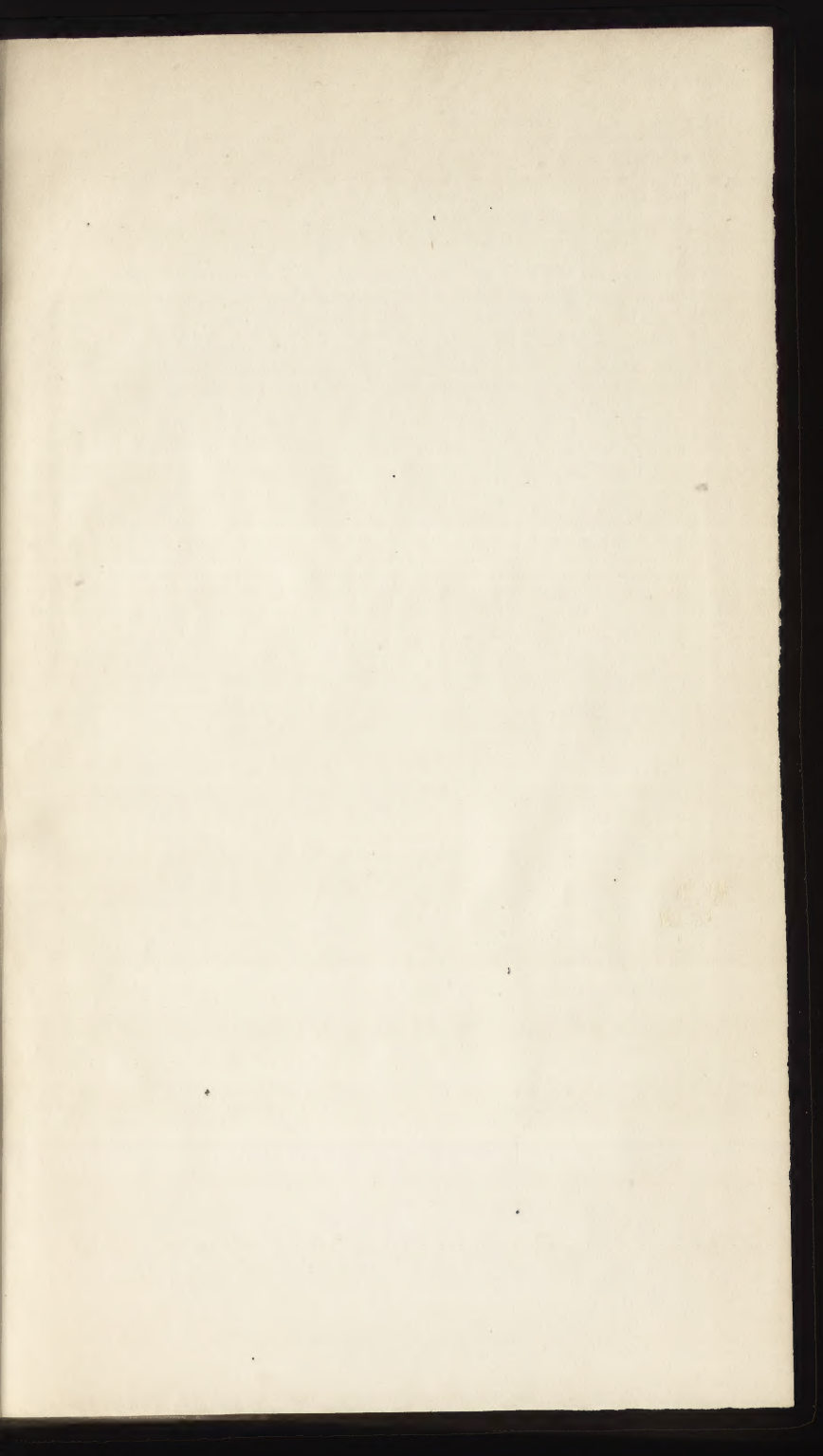
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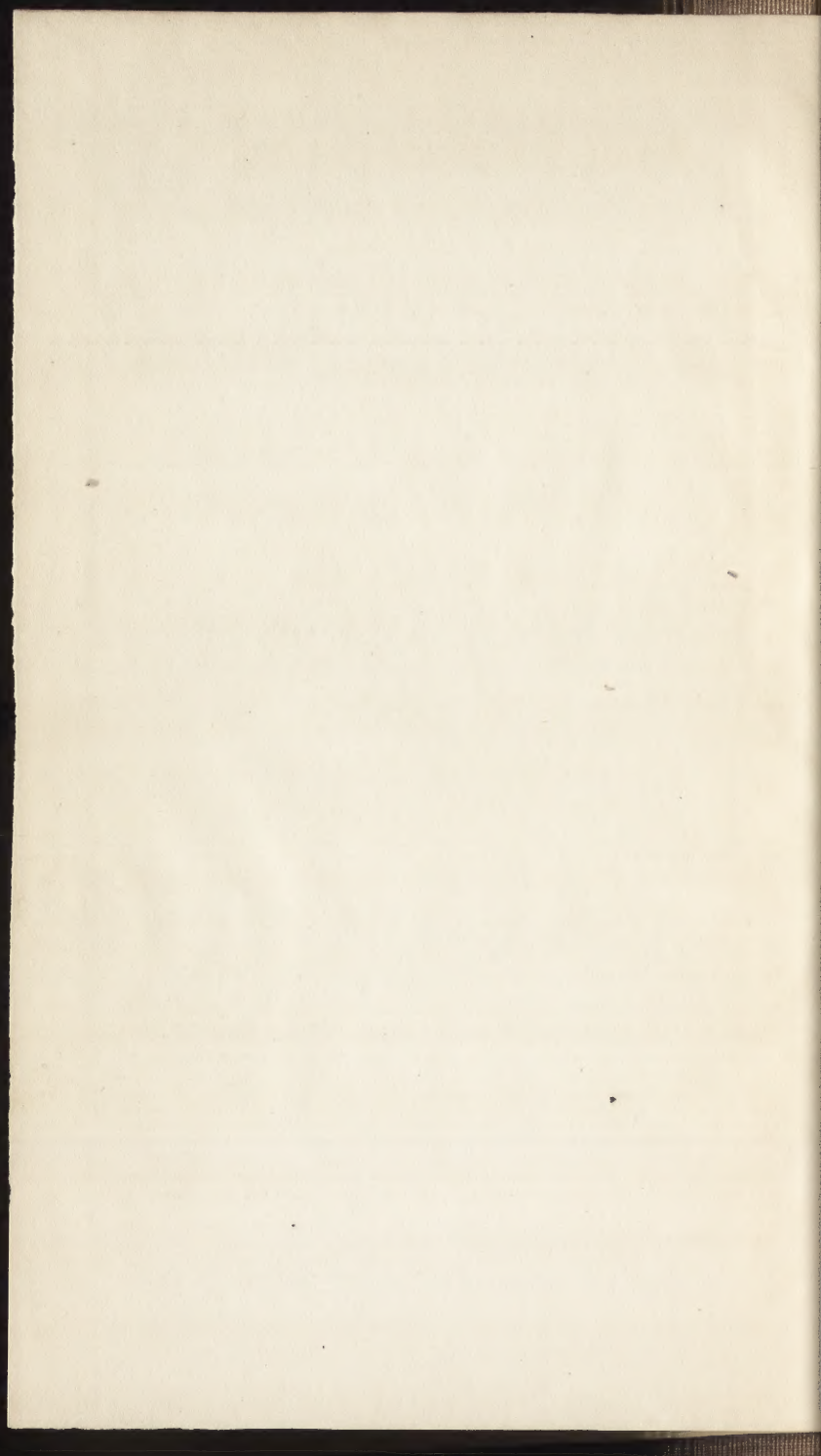


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ANNUAL OF SCIENTIFIC DISCOVERY.

NOTICES OF THE PRESS.

"Nothing which has transpired in the scientific world during the past year, seems to have escaped the attention of the industrious editors. We do not hesitate to pronounce the work a highly valuable one to the man of Science."—*Boston Journal*.

"This is a highly valuable work. We have here brought together in a volume of moderate size, all the leading discoveries and inventions which have distinguished the past year. Like the hand on the dial-plate, 'it marks the progress of the age.' The plan has our warmest wishes for its eminent success."—*Christian Times*.

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"The work will prove of unusual interest and value."—*Traveller*.

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"A most valuable, complete, and comprehensive summary of the existing facts of science; it is replete with interest, and ought to have a place in every well appointed library."—*Worcester Spy*.

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"One of the most useful books of the day. Every page of it contains some useful information, and there will be no waste of time in its study."—*Norfolk Democrat*.

"It is precisely such a work as will be hailed with pleasure by the multitude of intelligent readers who desire to have, at the close of each year, a properly digested record of its progress in useful knowledge. The project of the editors is an excellent one, and deserves and will command success."—*North American, Philadelphia*.

"Truly a most valuable volume."—*Charleston (S. C.) Courier*.

"There are few works of the season whose appearance we have noticed with more sincere satisfaction than this admirable manual. The exceeding interest of the subjects to which it is devoted, as well as the remarkably thorough, patient and judicious manner in which they are handled by its skilful editors, entitle it to a warm reception by all the friends of solid and useful learning."—*New York Tribune*.

THE POETRY OF SCIENCE;

OR, STUDIES OF THE PHYSICAL PHENOMENA OF NATURE

BY ROBERT HUNT,

AUTHOR OF "PANTHEA," "RESEARCHES ON LIGHT," ETC.

NOTICES OF THE PRESS.

"We know of no work upon science which is so well calculated to lift the mind from the admiration of the wondrous works of creation to the belief in, and worship of, a First Great Cause. * * * One of the most readable epitomes of the present state and progress of science we have perused."—*Morning Herald, London.*

"The design of Mr. Hunt's volume is striking and good. The subject is very well dealt with, and the object very well attained; it displays a fund of knowledge, and is the work of an eloquent and earnest man."—*The Examiner, London.*

"This book richly deserves the attention of the public. Its object, as may be surmised from the title, is to paint the poetical aspect of science, or rather to show that the deeper one investigates the mysteries of nature—whether in the formation of a continent, in the orbit of a star, or in the color of a flower—the more awakened will be his wonder and his veneration, and the more call will there be upon his highest powers of the intellect and the imagination."—*Boston Post.*

"It was once supposed that poetry and science were natural antipodes; and lo! they now are united in loving bonds. Mr. Hunt has certainly demonstrated that the divinest poetry lies hidden in the depths of science, and needs but a master spirit to evoke it in shapes of beauty."—*Christian Chronicle.*

"It may be read with interest, by the lovers of nature and of science."—*N. Y. Tribune.*

"It is written in a style not unworthy of the grandeur of the subject."—*N. Y. Eve. Post.*

"The author, while adhering to true science, has set forth its truths in an exceedingly captivating style."—*New York Commercial Advertiser.*

"We are heartily glad to see this interesting work re-published in America. It is a book that is a book."—*Scientific American.*

"From the arcana of science especially, has the author gleaned what may be properly termed her poetry, which will make the book one of the most interesting character to the intelligent reader."—*Christian Herald.*

"It is really a scientific treatise, fitted to instruct and enlarge the mind of the reader, but at the same time it invests the subjects it describes with the radiance of the imagination, and with the charming association of poetry. The book well deserves the title it bears, and is a beautiful illustration of the poetic interest that belongs to many of the discussions of the science."—*Providence Journal.*

"It is one of the most readable, interesting, and instructive works of the kind, that we have ever seen."—*Philadelphia Christian Observer.*

"In this admirable production, Mr. Hunt offers a beautiful epitome of the physical phenomena of Nature, in which, from their ultimate facts, he leads his reader by inductive processes, to the contemplation of vast eternal truths. Though full of information, the facts cited in his pages are not collected solely because they are such, but with true philosophical acumen, to build up the edifice; and if curious or rare, they are selected merely to strengthen the position in which they are placed."—*Washington Union.*

"We anticipate a wide circulation for it in this country."—*Albany State Register.*

"The scientific compass of the volume is large, and its execution is exceedingly fine and interesting."—*Zion's Herald.*

"We noticed this eloquent work, while it was in the course of publication. It is now out in beautiful style, and makes with the notes, which are full and as valuable as the text, a volume of nearly four hundred pages. The publishers could not have done the poets of the land a better service, than by thus supplying them with exhaustless materials, collected from all branches of science, and admirably arranged for their more substantial structure."—*Watchman and Reflector.*

"Here we have an illustration of the true and beautiful, and how that they are always one. The mysterious laws of nature, and the phenomena by which they are manifested, are brought before the reader in a way that enchants and improves. There is poetry in science, as no one may deny, after he reads this book."—*Baltimore Patriot.*

GOULD AND LINCOLN, PUBLISHERS, BOSTON.

FOOT-PRINTS OF THE CREATOR;

— OR —

THE ASTEROLEPIS OF STROMNESS.

BY HUGH MILLER.

WITH MANY ILLUSTRATIONS.

FROM THE THIRD LONDON EDITION.—WITH A MEMOIR OF THE AUTHOR

BY LOUIS AGASSIZ.

"In its purely geological character, the 'Foot-prints' is not surpassed by any modern work of the same class. In this volume, Mr. Miller discusses the development hypothesis, or the hypothesis of natural law, as maintained by Lamarck, and by the author of the 'Vestiges of Creation,' and has subjected it, in its geological aspect, to the most rigorous examination. He has stripped even of its semblance of truth, and restored to the Creator, as governor of the universe, that power and those functions which he was supposed to have resigned at its birth. * * * The earth has still to surrender mighty secrets,—and great revelations are yet to issue from sepulchres of stone. It is from the vaults to which ancient life has been consigned that the history of the dawn of life is to be composed."—*North British Review*.

"Scientific knowledge equally remarkable for comprehensiveness and accuracy; a style at all times singularly clear, vivid, and powerful, ranging at will, and without effort, from the most natural and graceful simplicity, through the playful, the graphic, and the vigorous, to the impressive eloquence of great thoughts greatly expressed; reasoning at once comprehensive in scope, strong in grasp, and pointedly direct in application,—these qualities combine to render the 'Foot-prints' one of the most perfect refutations of error, and defences of truth, that ever exact science has produced."—*Free Church Magazine*.

DR. BUCKLAND, at a meeting of the British Association, said he had never been so much astonished in his life, by the powers of any man, as he had been by the geological descriptions of Mr. Miller. That wonderful man described these objects with a facility which made him ashamed of the comparative meagreness and poverty of his own descriptions in the "Bridge-water Treatise," which had cost him hours and days of labor. *He would give his left hand to possess such powers of description as this man;* and if it pleased Providence to spare his useful life, he, if any one, would certainly render science attractive and popular, and do equal service to theology and geology.

"The style of this work is most singularly clear and vivid, rising at times to eloquence, and always impressing the reader with the idea that he is brought in contact with great thoughts. Where it is necessary, there are engravings to illustrate the geological remains. The whole work forms one of the best defences of Truth that science can produce."—*Albany State Register*.

"The 'Foot-Prints of the Creator' is not only a good but a great book. All who have read the 'Vestiges of Creation' should study the 'Foot-Prints of the Creator.' This volume is especially worthy the attention of those who are so fearful of the skeptical tendencies of natural science. We expect this volume will meet with a very extensive sale. It should be placed in every Sabbath School Library, and at every Christian fireside."—*Boston Traveller*.

"Mr. Miller's style is remarkably pleasing; his mode of popularising geological knowledge unsurpassed, perhaps unequalled; and the deep vein of reverence for Divine Revelation pervading all, adds interest and value to the volume."—*New York Com. Advertiser*.

"The publishers have again covered themselves with honor, by giving to the American public, with the Author's permission, an elegant reprint of a foreign work of science. We earnestly bespeak for this work a wide and free circulation, among all who love science much and religion more."—*Puritan Recorder*.

"The book indicates a mind of rare gifts and attainments, and exhibits the workings of poetic genius in admirable harmony with the generalizations of philosophy. It is, withal pervaded by a spirit of devout reverence and child-like humility, such as all men delight to behold in the interpreter of nature. We are persuaded that no intelligent reader will go through the chapters of the author without being instructed and delighted with the views they contain."—*Providence Journal*.

"Hugh Miller is a Scotch geologist, who, within a few years, has not only added largely to the facts of science, but has stepped at once among the leading scientific writers of the age, by his wonderfully clear, accurate, and elegant geological works. Mr. Miller, taking the newly-discovered Asterolepis for his text, has produced an answer to the 'Vestiges of Creation,' a work which has been more widely circulated, perhaps, than any other professedly scientific book ever printed. Mr. Miller (and there is no doubt of this) completely upsets his opponent—exposing his incompetency, ignorance, and sophistry, with a clearness, ease, and elegance that are both astonishing and delightful. Throughout the entire geologic portion, the reasoning is markedly close, shrewd, and intelligible—the facts are evidently at the finger's end of the author—and the most unwilling, cautious, and antagonistic reader is compelled to yield his thorough assent to the argument."—*Boston Post*.

GOULD AND LINCOLN, PUBLISHERS, BOSTON.

THE OLD RED SANDSTONE;

— OR —

NEW WALKS IN AN OLD FIELD.

BY HUGH MILLER.

FROM THE FOURTH LONDON EDITION—ILLUSTRATED.

A writer, in noticing Mr. Miller's "First Impressions of England and the People," in the *New Englander*, of May, 1850, commences by saying, "We presume it is not necessary formally to introduce Hugh Miller to our readers; the author of 'The Old Red Sandstone' placed himself, by that production, which was first, among the most successful geologists, and the best writers of the age. We well remember with what mingled emotion and delight we first read that work. Rarely has a more remarkable book come from the press. . . . For, besides the important contributions which it makes to the science of Geology, it is written in a style which places the author at once among the most accomplished writers of the age. . . . He proves himself to be in prose what Burns has been in poetry. We are not extravagant in saying that there is no geologist living who, in the descriptions of the phenomena of the science, has united such accuracy of statement with so much poetic beauty of expression. What Dr. Buckland said was not a mere compliment, that 'he had never been so much astonished in his life, by the powers of any man, as he had been by the geological descriptions of Mr. Miller. That wonderful man described these objects with a felicity which made him ashamed of the comparative meagreness and poverty of his own descriptions, in the Bridgewater Treatise, which had cost him hours and days of labor.' For our own part we do not hesitate to place Mr. Miller in the front rank of English prose writers. Without mannerism, without those extravagances which give a factitious reputation to so many writers of the day, his style has a classic purity and elegance, which remind one of Goldsmith and Irving, while there is an ease and a naturalness in the illustrations of the imagination, which belong only to men of true genius."

"The excellent and lively work of our meritorious, self-taught countryman, Mr. Miller, is as admirable for the clearness of its descriptions, and the sweetness of its composition, as for the purity and gracefulness which pervade it."—*Edinburgh Review*.

"A geological work, small in size, unpretending in spirit and manner; its contents, the conscientious narration of fact; its style, the beautiful simplicity of truth; and altogether possessing, for a rational reader, an interest superior to that of a novel."—*Dr. J. Pye Smith*.

"This admirable work evinces talent of the highest order, a deep and healthful moral feeling, a perfect command of the finest language, and a beautiful union of philosophy and poetry. No geologist can peruse this volume without instruction and delight."—*Silliman's American Journal of Science*.

"Mr. Miller's exceedingly interesting book on this formation is just the sort of work to render any subject popular. It is written in a remarkably pleasing style, and contains a wonderful amount of information."—*Westminster Review*.

"In Mr. Miller's charming little work will be found a very graphic description of the Old Redfishes. I know not of a more fascinating volume on any branch of British geology."—*Mantell's Medals of Creation*.

SIR RODERICK MURCHISON, giving an account of the investigations of Mr. Miller, spoke in the highest terms of his perseverance and ingenuity as a geologist. With no other advantages than a common education, by a careful use of his means, he had been able to give himself an excellent education, and to elevate himself to a position which any man, in any sphere of life, might well envy. He had seen some of his papers on geology, written in a style so beautiful and poetical as to throw plain geologists, like himself, in the shade.

GOULD AND LINCOLN, PUBLISHERS, BOSTON.





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Gould & Lincoln, Boston.

THE ANNUAL
OF
SCIENTIFIC DISCOVERY:

OR,
YEAR-BOOK OF FACTS IN SCIENCE AND ART.

EXHIBITING THE
MOST IMPORTANT DISCOVERIES AND IMPROVEMENTS IN

MECHANICS,	ASTRONOMY,	MINERALOGY,
USEFUL ARTS,	METEOROLOGY,	GEOLOGY,
NATURAL PHILOSOPHY,	ZOOLOGY	GEOGRAPHY,
CHEMISTRY,	BOTANY,	ANTIQUITIES,

TOGETHER WITH A LIST OF RECENT SCIENTIFIC PUBLICATIONS;
A CLASSIFIED LIST OF PATENTS; OBITUARIES OF EMINENT
SCIENTIFIC MEN; AN INDEX OF IMPORTANT PAPERS
IN SCIENTIFIC JOURNALS, REPORTS, ETC.

EDITED BY
DAVID A. WELLS, A. M.,
OF THE LAWRENCE SCIENTIFIC SCHOOL, CAMBRIDGE,
AND
GEORGE BLISS, JR.

BOSTON:
GOULD AND LINCOLN,
59 WASHINGTON STREET.
1851.

Entered according to Act of Congress, in the year 1851, by
GOULD AND LINCOLN,
in the Clerk's Office of the District Court of the District of Massachusetts.

CAMBRIDGE:
STEREOTYPED BY METCALF AND COMPANY,
PRINTERS TO THE UNIVERSITY.

Boston: G. C. RAND, Printer, Cornhill.

PREFACE.

IN presenting to the public the second volume of the *Annual of Scientific Discovery*, the Editors desire to say a few words concerning its objects and character. It is not our intention to notice all that transpires of interest in the world of science from year to year, but, exercising a proper discretion, to select and condense what we deem of general importance and interest, so as to bring it within the space allowed us. This course we have endeavoured to pursue impartially, sparing neither labor nor expense; and if it may seem that undue prominence has been given to transactions or discoveries emanating from any particular locality, a reason will be found in the fact, that either more has been accomplished there, or that what has been accomplished has received greater publicity. While we have, in general, made our selections from standard authorities, we have yet, in some cases, departed from this rule, and we may here say, once for all, that we do not hold ourselves responsible for the accuracy of the statements made, our task being to present a correct abstract of what we meet with in our examinations.

The Report of the New Haven meeting of the American Association not having been officially published, we have derived our notices of its proceedings from the full reports published in some of the newspapers, and from private sources.

The general features of the work remain unchanged, but important additions have been made, and no pains have been

spared to improve it in every particular. Among these additions are the Meteorological Tables, prepared expressly for us, the tables of Weights and Measures, and the Review of the Year, into which, while glancing at the progress made in the world of science, we have introduced much interesting information.

In regard to the Index to Articles in Scientific Journals, we would say, that it is not intended to be a *complete* index to such journals, but simply to embrace references to such articles as contain important or interesting information, and are not noticed in the body of the work. Great irregularity has been experienced in the reception of our foreign journals, which fact will account for some apparent omissions on our part. Want of room has compelled us in general to omit extracts from new books sent us, but we shall endeavour to supply the defect hereafter.

The favorable reception which the Annual has received insures its continued publication, but it is highly probable that hereafter some important changes will be made in it, by which its value will be further increased. We should be happy to receive original communications, provided they are in our hands as soon as the first of December.

CAMBRIDGE, February 1, 1851

NOTES BY THE EDITORS

ON THE

PROGRESS OF SCIENCE IN 1850.

THE half-century which ended with the year 1850 has been an eventful one in the annals of science, and especially of American science. However interesting and instructive it would be to trace its progress, we shall content ourselves with the narrower task of a cursory review of the scientific world during the single year which has just closed, introducing some items of information which we believe will be found interesting.

The American Association for the Advancement of Science has held two meetings during the past year. The first, a semiannual meeting, at Charleston, S. C., which commenced March 12th, and continued five days. The whole number of papers presented was forty-eight, of which eighteen pertained to mathematical and physical science, and the remainder to subjects connected with natural history. Among the latter was one from Dr. St. Julien Ravenel, of Charleston, announcing one of the most important discoveries of the year, viz. "that the development of tissues is parallel to the growth of individuals." This paper unfortunately has never been published. Prof. A. D. Bache presided at this meeting. The greatest hospitality, both public and private, was extended to the members by the city and its inhabitants. With an unexampled generosity, the Corporation of Charleston assumed all the expenses of the Association in publishing the papers and proceedings of the meeting, the whole forming a volume of 215 pages.

The second and annual meeting of the Association commenced at New Haven, Aug. 19th, and continued one week, Prof. Bache presiding. The number of members in attendance was larger than ever before, and the papers offered covered a wide range of subjects. The annual address was delivered by Prof. Henry, the retiring President of the Association.

At this meeting various measures were adopted which are calculated to

place the Association upon a more effective and permanent basis than it has previously occupied. Among these were the election of a general secretary, a permanent secretary, and a permanent treasurer, the two latter to hold office for three years. The permanent secretary will receive a salary of \$300 per annum, and will superintend the publication of the proceedings and conduct the correspondence of the Association. The annual subscription of the members was raised to three dollars, the continuance of the membership being made dependent upon its payment. For the year 1851, the Association voted to hold the semiannual meeting at Cincinnati, commencing the first week in May, and the annual meeting at Albany, commencing the third Monday of August. A resolution was also adopted requesting Prof. Henry to deliver an address at the meeting in Cincinnati, "Upon the present condition of American science and the means for its advancement." The following officers were elected for the ensuing year: — Prof. Agassiz, President; Prof. W. B. Rogers, General Secretary; Prof. Spencer F. Baird, Permanent Secretary; Dr. Elwyn, Treasurer. Among the numerous members elected at this meeting were Miss Maria Mitchell, of Nantucket, Mass., and Miss Morris, of Pennsylvania.

The twentieth annual meeting of the British Association commenced in Edinburgh, on July 31, and continued for one week. It was more numerously attended than usual, and eminently successful in all its objects. Sir David Brewster, the President, in assuming the chair, briefly alluded to the progress made in several departments of science since the former meeting of the Association. In his glance at astronomy, he stated that Mr. Lassell, of Liverpool, had recently been able to observe "the very minute, but extremely black shadow of the ring of Saturn upon the body of that planet. He observed the line of shadow to be notched, as it were, and almost broken up in a line of dots; thus indicating mountains upon the plane of the ring." After noticing in a highly complimentary manner the new law discovered by Mr. Daniel Kirkwood, of Pennsylvania, he says: — "This law requires the existence of a planet between Mars and Jupiter, and it follows from the law that the broken planet must have been a little larger than Mars, or about 5,000 miles in diameter, and that the length of its day must have been about $57\frac{1}{2}$ hours. The American astronomers regard this law as amounting to a demonstration of the nebular hypothesis of Laplace; but we venture to say that this opinion will not be adopted by the astronomers of England."

"It has been long known that the imperfect transparency of the earth's atmosphere, and the unequal refraction which arises from differences of temperature, combine to set a limit to the use of high magnifying powers in our telescopes. The Marquis of Ormond is said to have seen from Mount Etna, with his naked eye, the satellites of Jupiter. If this be true, what discoveries may we not expect from a large reflector working above

the grosser strata of our atmosphere!" The British Association, at a former meeting, had, in consequence of these views, petitioned the government to establish a powerful telescope at some point in the southern hemisphere; this request Sir David Brewster thought would be granted. He also recommended the formation in England of an association similar to the French Academy, composed of men eminent for scientific usefulness, who might be enabled by means of a fund to devote themselves wholly to scientific research for the public benefit.

The next meeting of the British Association will be held at Ipswich. The President for the ensuing year is Mr. Airy, the Astronomer Royal.

The Report of the Regents of the Smithsonian Institution contains much information as to the operations of that noble foundation. The memoirs are published separately, and afterwards bound into volumes, and it is proposed that hereafter copies of all the publications shall be sold at a price merely sufficient to cover the cost of printing. Among the publications made or announced during the year are, — *Researches on Neptune*, by Sears C. Walker; *Vocal Sounds of Laura Bridgman*, by Dr. Lieber; *Microscopic Examination of Soundings made by the U. S. Coast Survey*, by J. W. Bailey; *Physical Geography of the Mississippi Valley*, by Charles Ellet, Jr.; *Mosasaurus and Allied Genera*, by Dr. R. W. Gibbes; *Antiquities of Western New York*, by E. G. Squier; *Embryological Classification of Insects*, by Prof. Agassiz; *Explosiveness of Nitre*, by Dr. Hare; *Occultations for 1851*, by John Downes; *Ephemeris of Neptune, for 1851*, by S. C. Walker; *Report on the Discovery of Neptune*, by B. A. Gould. Mr. Walker calculated from recent observations an empirical orbit of Neptune for its whole revolution of 166 years, from which he was led to conclude that Lalande had observed this planet on May 10, 1795. Examination showed that this was the case, but owing to its change of place Lalande had marked it "doubtful." From these data Mr. W. was enabled to calculate a pure elliptical orbit, and Prof. Peirce has calculated the perturbations in its motion caused by the other planets. By calculating the effect of Neptune on the other planets, he has explained for the first time since its discovery the anomalies in the motions of Uranus.

The Institution has awarded a small premium to Miss Mitchell, of Nantucket, the discoverer of the comet known by her name. A grant was also made to Lieut. Gilliss for furnishing him with instruments for his observations in Chili, but Congress has refunded the sum advanced. It is, however, proposed to send him some improved instruments.

Collectors of objects in natural history have been sent to Oregon, California, and Mexico, by private gentlemen, with whom the Institution co-operates. A collector has returned from New Mexico laden with a valuable collection of plants, seeds, &c., a complete set of which the Institution will receive, while the others will be divided among those who subscribed to defray the expenses. They will be described by Dr. Gray in

the "Contributions." The same collector is now exploring the region around El Paso. Another collector is engaged in exploring the great valley of the Salt Lake.

Some progress is making in obtaining descriptions of the ancient monuments of our country. The Territory of Minnesota has established a Historical Society for this purpose. An ethnological chart of this country is preparing. The *Bibliographia Americana*, a catalogue and account of every book published in, or relating to, North America, prior to 1700, with references to the libraries where they are to be found, is making good progress. Prof. Gray is preparing a report on the forest trees of North America, to be illustrated with figures of the flowers, leaves, fruit, &c., of the natural size, both colored and plain. It is to consist of three parts, in octavo, with an atlas of quarto plates, and will be preceded by a dissertation on our knowledge of the anatomy, morphology, and physiology of the tree, with drawings from original dissections under the microscope. The collection of instruments is increasing. At an expense of about \$140, a collection of upwards of 10,000 specimens of vertebrated animals, principally reptiles and fishes, has been obtained. A series of lectures is given each winter by distinguished men of this and other countries, which are well attended. Lindheimer's collections, made near Houston and west of the Colorado, in 1843-44, have been described, and those made in 1845-48 are now being examined.

Among the official scientific publications of the past year are the Reports on the Mineralogy and Geology of the Lake Superior Mining Region, by Dr. Charles T. Jackson; on the Geology of Alabama, by Prof. M. Tuomey; of the Patent-Office for 1849, by Thomas Ewbank; on the Progress of the Coast Survey, by Prof. Bache; and on the Geology of California, by Messrs. Tyson, Talbot, Riley, and others.

The results of the Exploring Expedition, under Capt. Wilkes, are gradually being presented to the world in a series of works on the different departments of science, of which several volumes have been already published under the care of the most distinguished scientific men of our country. Prof. Gray is engaged upon the Botany, and is now in Europe for the purpose of inspecting the various herbaria which may assist him in so important an undertaking. The description of the shells collected has been intrusted to Dr. A. A. Gould, and the work is in a forward state of preparation. It will form a volume of about 500 pages, with an atlas of 60 plates, containing upwards of 3,000 figures. The fishes will be described by Prof. Agassiz. The previous volumes of the series are among the most valuable contributions ever made to American science, and the well-known ability of the gentlemen intrusted with the remaining volumes is a guarantee that they will be in no respect inferior to those already issued. The "Races of Men," by Dr. Pickering, has, since its publication, been republished in England in a cheap form, and so extensively circu-

lated, that it is much better known than in this country, where its high price has confined it almost exclusively to scientific men.

The American Journal of Science and Arts, in entering upon its sixty-first volume, the eleventh of the new series, adds to its list of editors the name of Dr. Wolcott Gibbs. It is to be hoped that Prof. Silliman is at length reaping the reward for his energy and perseverance in establishing, and continuing through long years of discouragement and pecuniary loss, the first and best scientific journal in America.

The Astronomical Journal has been issued at irregular intervals, under the care of Dr. B. A. Gould, Jr., as materials accumulated, twenty numbers having been published before the close of the year. Eight gentlemen subscribed \$700 for its support, and one of them agreed to meet the remaining expenses of the year. The original communications on astronomy and pure mathematics which it has contained are of the highest character.

The Messrs. Appleton, the well-known publishers of New York, issued on Jan. 1st, 1851, the first number of "Appletons' Mechanics' Magazine and Engineers' Journal," edited by Julius W. Adams. It is to appear monthly, taking as its pattern the London Mechanics' Magazine. It is beautifully printed, and contains both original communications and selections. It occupies a somewhat different field from that already filled by the Scientific American and the Farmer and Mechanic, and supplies a want which has long been felt.

The Daguerrean Journal, devoted to the Daguerrean and photogenic art, was established in October, by Mr. S. D. Humphrey, of New York. As an evidence of the necessity for such a publication, the editor states that there are now upwards of 10,000 persons, in the United States, engaged in the various processes dependent upon photography.

At its meeting at New Haven, the American Association passed a resolution in favor of the establishment of a Zoölogical Journal. It is to be conducted by Professors Agassiz and Wyman of Cambridge, Dana of New Haven, Leidy of Philadelphia, and Baird of the Smithsonian Institution.

The preparation of the American Nautical Almanac is progressing rapidly. Finding that the tables of Bessel and Hansen would not be published as soon as was expected, Lieut. Davis has caused tables to be prepared for provisional use, by enlarging and correcting some of the old ones. A new set of tables of Mercury has been commenced, and various improved modes of computation have been introduced for lessening the labor and increasing the accuracy. Means have been adopted for facilitating observations of the solar eclipse of July 28, 1851, and many advantages are anticipated from a comparison of calculations and observations.

Lieut. Maury is about to present to Congress an elaborate report, giving a connected view of the results obtained by the observations on the

winds and currents of the ocean, carried on and reduced under his care. More than 1,000 vessels are daily and hourly engaged in making observations on the winds and currents, rains, calms, storms, electrical phenomena, fogs, clouds, drift, temperature of the air and water, &c. The abstract logs already received make 200 volumes, averaging from 2,000 to 3,000 days' observations, and the number is increasing faster than they can be reduced. "Pilot Charts," showing the point of the compass from which the wind blows in all parts of the ocean for any month in the year, have been already published for the North Atlantic and for Brazil, within the trade-wind region. Those for the South Atlantic and the Pacific, from the equator to 60° S., and from 70° to 120° W., are in press, while those for the entire Pacific and for the Indian Ocean are in a forward state of preparation. The object is to procure at least a hundred observations for each month in the year for every square into which the ocean is divided. This would require for the three great oceans 1,669,200 observations of the winds alone. In some squares and for some months, over 1,000 observations have been obtained, while for neighbouring squares not a single one has been received. These investigations will shorten the passage to Europe about a day, and that to the equator from two days to two weeks, according to the season. Over 20,000 sheets of the wind charts have been distributed, and the demand is increasing. A thermal chart of the North Atlantic, exhibiting the temperature of the surface-water, in eight sheets, is in press, while a similar one of the South Atlantic is nearly ready. Among other results, they indicate a vibratory motion of the Gulf Stream, varying with the season of the year.

At the annual meeting of the Royal Geographical Society of London, the Patron's or Victoria gold medal was presented to the Hon. Abbott Lawrence, for transmission to Col. Fremont, in token of the appreciation of his contributions to the geography of Western America.

The Geographical Society of Paris has bestowed its annual prize upon the two brothers D'Abbadie, for their travels and explorations in Abyssinia, prosecuted for eleven years, from 1837 to 1848.

Among the prizes awarded by the French Academy are, one of 2,500 francs to M. Leclaire, for the application of zinc-white as a paint; one to M. Rocher for an apparatus for distilling sea-water; one, each, to Drs. Jackson and Morton, for their share in the discovery of the anæsthetic effects of ether; and to Messrs. Galle, Hencke, Hind, Graham, and Gasparis, for astronomical discoveries.

The survey of the coast of the United States is steadily advancing. The trigonometrical portion now extends unbroken from Portland, Me., to within fifty miles of the Capes of the Chesapeake, and, with an interval of about one hundred miles, to a point beyond Cape Hatteras. It has been commenced in South Carolina, Georgia, Florida, Louisiana, and Texas, while it is complete in Alabama, and nearly so in Mississippi.

The other operations follow closely upon the trigonometry. Parties are also employed on the Pacific coast. The last seven years have shown a gain in economy of one and three quarters to one over the expenditure before that time for the same work. It is to be hoped that the proposition to place the survey in charge of the officers of the navy solely, will not succeed.

The party connected with the Mexican Boundary Commission contains among its members several scientific gentlemen, who will, it is believed, find a rich harvest in the as yet comparatively unexplored portion of our country to which they have gone.

The Russian Geographical Society has decided upon exploring that portion of the Northern Ural which lies between Mount Kwognar and the pass of Koppol, an extent of 2,000 wersts.

It is well known that numerous expeditions have been sent from Great Britain in search of Sir John Franklin. Two vessels purchased and equipped by Mr. Henry Grinnell, of New York, but furnished with crews and officers from the U. S. Navy, have also joined in this praiseworthy effort. At the last accounts they had made considerable progress, but had discovered nothing. During the year, however, some of the English vessels have discovered what are pronounced to be undoubted traces of the lost navigator, but they only indicate his position in 1845, the first year of his absence.

The committee appointed by the American Association on the subject of an American Prime Meridian have reported, that, of the twelve of their number who have given opinions on the subject, five were in favor of the old standard, five of the new, and two for using the former for nautical, and the latter for geographical and astronomical purposes. These views were communicated to a committee of Congress, who advised the retaining the Greenwich zero of longitudes for navigators, and the adoption of the meridian of the National Observatory "for defining accurately and permanently territorial limits, and for advancing the science of astronomy in America."

A movement has been made in Europe for the introduction of a new and universal meridian, that of Cape Horn being the one suggested.

In 1847 Dr. Gerling suggested the importance of a new determination of the sun's parallax, by observations upon Venus, at and near her stationary periods, inasmuch as the received parallax rests entirely upon observations of the transit of Venus in 1769, the results derived from which differ by an entire second, thus leaving the dimensions of the solar system somewhat doubtful. By simultaneous observations on Mars in the northern hemisphere, and on Venus in the southern, this error may be corrected. The importance of this matter having been represented to Congress, in August, 1848, they authorized the fitting out of an astronomical expedition to Chili, for the purpose of making the necessary observations

of Venus, in connection with the National Observatory at Washington. This expedition was placed under the charge of Lieut. Gilliss, U. S. Navy. Suitable buildings were shipped to Chili, as well as two telescopes equatorially mounted, a meridian circle, a clock, and three chronometers. The expedition sailed several months since, and at the last accounts observations had already been commenced at Santiago. The observations especially contemplated consist of differential measurements during certain portions of 1849, 1850, 1851, and 1852, upon Mars and Venus, with certain stars along their paths. In spite of bad weather, Lieut. Gilliss had in ten nights in June, with eight zones, made 444 observations; in sixteen nights in July, with nine zones, 528 observations; in twenty nights in August, with ten zones, 576. From the middle of February to September 22d, not much short of 5,000 stars had been observed, and this number would probably be increased to 20,000 during the ensuing season.

A new wing is in process of construction at the Observatory at Cambridge, which is to be devoted in part to astronomical, and in part to meteorological purposes. It is to contain a comet-seeker constructed upon a new plan, by which it is expected that the labor of searching for these transient visitors to our sphere will be considerably diminished. A set of self-registering photographic instruments will be placed in the basement, from which important results may be expected. In the remainder of the building there will be a computing room and a library, to the collection of which a very liberal sum can now be annually devoted. If it is deemed advisable, other instruments can be introduced. The expense of the building is defrayed by a subscription raised through the efforts of J. Ingersoll Bowditch, Esq., of Boston.

During the past year such measures have been adopted as will, it is believed, secure the erection of an observatory at Brooklyn, N. Y. Over \$20,000 have been already subscribed, but nearly as much more is required. It is proposed to procure a first-class refracting telescope, a meridian-circle, a clock, and various smaller instruments.

The longitude of Cambridge Observatory west from Greenwich, as deduced from a comparison of 116 chronometers conveyed from Liverpool to Boston in thirty-four voyages of the Cunard steamers, in 1848, is $4^{\text{h}}. 44^{\text{m}}. 30^{\text{s}}.5$; that deduced from lunar occultations and solar eclipses is $4^{\text{h}}. 44^{\text{m}}. 31^{\text{s}}.7$, while that deduced from 87 additional comparisons of chronometers in 1849 differs nearly two seconds of time from that previously obtained by astronomical observations.

The volume containing the observations made at the National Observatory in 1846 embraces a catalogue of some 12,000 or 15,000 stars, most of them unknown to any existing catalogues. It forms a quarto of not less than 1,000 pages, and is the largest work of the kind ever published by any observatory as the result of a single year's labor.

Nowhere has more activity been displayed during the past year than in

the department of meteorology. The Smithsonian Institution now receives about one hundred and fifty monthly returns from localities widely separated from each other, and distributed over different portions of the United States. There are three classes of observers. One class records the aspect of the sky, direction of the wind, beginning and end of rain, snow, &c.; another, besides these, notices the temperature; and the third is furnished with a full set of instruments for recording the most important atmospheric changes. In this way we may hope to ascertain the place of origin, direction, and velocity of motion of a storm, as well as the direction and velocity of the wind composing it, whether gyratory or inward and upward. The record of meteors will furnish data for determining their elevation and velocity. The instruments have been carefully made in New York, and the barometers are compared with a standard one procured in London. Congress has appropriated \$2,000 to be expended under the direction of Prof. Espy in a series of experiments having an important bearing on the explanation of meteorological phenomena. Since 1825 a system of meteorological observations has existed in New York, under the direction of the Regents of the University of that State, but it has now been reorganized under the care of Prof. Guyot so as to conform to that of the Smithsonian Institution. Massachusetts has also made a movement towards organizing a similar system, and the medical department of the army is to unite with the Institution, while observations are expected from various places in Canada, Bermuda, the West India Islands, and Central America. It should be mentioned here that the daily newspapers of New York receive by telegraph abstracts of the state of the weather at a large number of places, and, under the direction of the Smithsonian Institution, it is expected that the telegraph will soon be made of great use in forwarding such information. The Institution has furnished a set of magnetic apparatus to Col. Emory, of the Mexican Boundary Commission.

A meteorological society has been formed in Great Britain with the object of promoting in every way the pursuit of meteorological investigations. Samuel C. Whitbread is President, and James Glaisher Secretary.

A magnetic and meteorological observatory has been completed at St. Petersburg, Russia. It is intended to form a central point for the magnetic and meteorological observations of the whole Russian empire. Its director has the general superintendence of all the other stations, and thus in a short time a very extensive and accurate system of observations will be in operation, from which important results may be expected.

A society has been formed in London for the investigation of the laws and nature of epidemic diseases. Dr. Babington is President.

The American Academy have voted to adopt the French system of weights and measures in all their publications, and at the same time have expressed a desire for a new and universal thermometric scale.

At the Charleston meeting of the American Association, the question of the unity of the human race was brought up, and has since received considerable attention. The investigations of Prof. Agassiz have led him to the following conclusion as expressed to the Association. As a general proposition, he would side with those who maintain the doctrine of the unity of the race, if by the unity of the race be meant nothing more than that all mankind were endowed with one common nature, intellectual and physical, derived from the Creator of all men, were under the same moral government of the universe, sustained similar relations to the Deity, and were alike appointed to retribution and immortality beyond the grave. It was quite a different question, whether the different races were derived from the same common human ancestors. For his own part, after giving to this question much consideration, he was ready to maintain that *the different races of men were descended from different stocks*, and that the Mosaic history did not conflict with this view. The Jewish history was the history, not of diverse races, but of a single race of mankind; but the existence of other races was often incidentally alluded to, and distinctly implied, if not absolutely asserted, in the sacred volume.

An able work in opposition to the above views has been published during the past year, by Dr. Bachman, of Charleston, and numerous essays of considerable merit have also appeared on the same side. On the other hand, some productions have been published, which it would have been better both for the credit of the authors and the liberality of the age had they remained in oblivion. The question, it appears to us, is wholly a scientific one, and must be met as such. The results of investigations as yet unpublished and unknown to the public are, in our opinion, stronger in support of Prof. Agassiz's views than any yet brought forward, but whether conclusive or not the public will have an opportunity of deciding. The recent researches of Prof. Owen, Dr. Neil, and Mr. P. A. Browne of Philadelphia, tend incidentally to the same end.

Besides the foundation which has been already laid by the Smithsonian Institution for an extensive collection of philosophical and chemical apparatus, and for a museum, several other institutions and societies in this country have within a recent period added greatly to their collections. A valuable donation of casts of Himalaya fossils has been made to the Boston Society of Natural History, from the English East India Company. This collection is peculiarly rich in Pachydermata, especially mastodons and elephants, and will add a number to the species of both these genera. A museum of natural history has been founded at Charleston, S. C., and from the extensive donations already made to it by Messrs. Holmes, Tuomey, Bachman, Ravenel, and others, bids fair to become one of the most extensive in the United States. The extensive collections of Prof. Agassiz have also been placed in the Lawrence Scientific School, at Cambridge. This collection in some respects is the most complete in existence, and in

others is only excelled by some of the celebrated museums of Europe. Williams College has been so fortunate as to procure the celebrated mineralogical and geological cabinet of Dr. Emmons, numbering several thousand specimens; this addition makes the cabinet of this institution more nearly equal the collections at New Haven and Amherst, the largest in the country. Valuable additions have been made to the State Cabinet of New York, of fossils, by gift from Prof. Hall, and an extensive collection of Indian relics and curiosities, by purchase. The latter are described in the Report of the Regents of the University of New York.

Gov. Hunt, in his message to the Legislature of New York, advocates "the creation of an institution for the advancement of agricultural science and of knowledge in the mechanic arts." A movement in favor of an Agricultural College has also been made in the Legislature of Massachusetts, and in several of the other States, especially in Ohio, where Prof. Mather is at the head of the enterprise, and in Maryland, where a valuable report has been published by Dr. Higgins.

A movement has been made towards establishing an extensive zoölogical and botanical garden in the vicinity of New York. It is proposed to have an incorporated company with a capital of \$300,000, of which sum \$100,000 are to be devoted to the purchase and preparing of about 200 acres of land, and to procuring animals and plants, while the remainder is to be invested.

Prof. C. C. Jewett developed to the American Association a plan for stereotyping the catalogues of libraries. It consists in stereotyping the titles of the books separately, so that they may be transposed in any way, and a title once made will serve for the catalogues of all libraries containing that work.

Inasmuch as time only can demonstrate the value of any invention in the mechanic arts, it is obviously impossible to speak of the excellence of any particular machine invented during the past year, and we pass them over one and all. The greatest achievement of modern engineering art, the Britannia Bridge, has been brought to a successful completion, and has been in daily use for some months past. The report on the application of iron to railway structures made by commissioners appointed by the British government, after a long series of experiments, is of great importance, detailing, as it does, many new and unexpected facts. Should experiments now in progress demonstrate the success of the alleged improvement in the preparation of flax, its influence, especially upon this country, can hardly be overrated. Since the close of the year a printing-press capable of producing 20,000 impressions per hour has been put in operation in New York.

In Natural Philosophy researches have been more than usually numerous and interesting. Prof. Page's investigations upon the application of electro-magnetism as a motive power, are important, but very much remains to

be done before this mysterious power can be practically used as a motor. Mr. B. A. Gould's researches on the velocity of the electric current, while they add to the laborious investigations upon this point, reduce the velocity within quite narrow limits. It is worthy of remark, that all the investigations upon this subject, except those of Wheatstone and Steinheil, have been made by American physicists. Prof. Faraday's researches on the magnetism of oxygen open a new and extensive field for research and theory. The veteran Arago, finding himself threatened with total blindness, has presented to the French Academy the results of his investigations upon light, but as yet only brief notices of them have appeared. The question between the two theories of light seems now to be put at rest, the decision being in favor of the undulatory view, while the absolute identity of light and heat has been rendered almost certain. In photography improvements are multiplying so fast, that the time seems not to be far distant when colored photographs will rival the productions of the painter.

The connection of England and France by means of a submarine telegraph across the Straits of Dover was accomplished in August, but the wire was soon afterwards broken. The practicability of the plan was, however, fully demonstrated, and the enterprise will soon be resumed, under conditions which will insure the stability of the connection. A plan has been also matured for passing a line of telegraph across the Irish Channel, and many do not hesitate to predict that the day is not far distant when, by means of a submarine telegraph, the daily news of Europe and the United States will be published simultaneously in both countries. In the trial which has been had of the celebrated patent case of *Morse v. House*, for infringement, the U. S. Circuit Court has decided in favor of the defendant. The plaintiff has, however, appealed.

A series of experiments made by M. Despretz proves that almost every solid body in nature is capable of complete fusion and volatilization. It has been also stated, that Despretz has succeeded in artificially producing a diamond; but this must be incorrect, as he has announced his opinion that the diamond is not the product of any intense heat upon organic or carbonaceous matters. The discovery of M. Ullgren has added aridium to the number of metals, and increased the whole number of supposed elementary substances to 64. The researches of M. Chatin and others show that the distribution of iodine over the earth's surface is far more extensive than has been hitherto supposed, while the method of extracting this substance from marine plants, made known by Mr. Kemp, will rank as one of the most useful discoveries of the year. No little excitement has been caused by the announcement of a discovery claimed by Henry M. Paine, of Worcester, Mass., by which hydrogen gas is liberated by a simple process from water, in great quantities, without any corresponding quantity of oxygen, and afterwards rendered exceedingly luminous on ignition by simply passing through cold spirits of turpentine. This claim, so entirely

at variance with the principles of chemistry, is, we think, disbelieved, in whole or in part, by all scientific men in the country, and before the truth shall be established by the only proper tribunal, we are not disposed to give it credit.

A recent letter of Baron Liebig to Prof. Horsford mentions a beautiful process, discovered by himself, for analyzing atmospheric air. He has found that one part of pyrogallic acid dissolved in five of water, and added to a solution of potassa, gives a liquid that will absorb oxygen as rapidly as a pure potassa solution does carbonic acid. Availing himself of this fact, he has been enabled by a simple process to make analyses of atmospheric air equal to the best heretofore obtained by other processes.

Large quantities of phosphate of lime have been discovered in New Jersey by Messrs. Jackson and Alger, of Boston, and the latter gentleman has purchased the vein with the intention of introducing the mineral for agricultural purposes. A deposit of the same substance, discovered near Crown Point, N. Y., in 1846, by Dr. Emmons, is also being worked to a considerable extent under his direction. The important bearings of these discoveries upon the agriculture of our country can hardly be overrated.

Among the most valuable contributions made to American science during the year are the results attained to by the expedition under Lieut. Walsh, in the schooner Taney, sent out at the instigation and under the direction of Lieut. Maury. It appears that the depth of the Atlantic Ocean, in some places, is more than six statute miles, which far exceeds the height of any mountain upon the surface of the globe. In some localities, at least, the water at a very considerable depth is found to be of less specific gravity than that at the surface.

The investigations of Messrs. Logan, Hunt, and others, upon the geological survey of Canada, show that the Silurian formation extends as far north as the mouth of the St. Lawrence.

The potato disease continues to prevail, and excites much attention. Opinions as to its cause and origin, and consequently as to the preventives and remedies, are as various as ever; but the whole matter is involved in much obscurity, and all that can be said is, that it is a dark point, which the lamp of science has as yet been unable to illuminate. It appears, however, that potatoes raised from seeds of the native potato, procured in South America, are as much affected by the disease as others.

The discovery, that the function of the pancreas in the animal economy is the dissolving of the fatty substances in food, forms another contribution to our knowledge of the operations of nature.

The discovery in New Zealand of a living specimen of the Moho, a bird of which fossil bones had previously been found and described under the name of *Notornis Mantelli*, has an important bearing on the question of the existence of the fossil birds of that region contemporaneous with those now living, and confirms the views of Prof. Owen and others on this

point. Within a very recent period an announcement has been made of the discovery of a wingless bird on Lord Howe's Island, situated between New Holland and Norfolk Island, which adds another link to the chain of evidence. Specimens of this bird, which is about the size of the rail, are now on their way to England.

The active labors of astronomers have been rewarded by an unusual number of important discoveries. Three new planets have been added to the list of those known, two of them discovered by Gasparis, the discoverer of Hygea, and one by Mr. Hind, the discoverer of Iris and Flora. The whole number of planets is now twenty-one, nine of which have been discovered within the last five years. A third ring of Saturn has been observed by the Messrs. Bond, whose previous observations upon that planet are well known. Three of those erratic visitors to our sphere, comets, have been detected, two of them by Mr. Bond. One of these is identical with that known as Faye's, discovered in 1843, and adds another to the increasing list of periodic comets. Of the supposed periodic comet of 1264 and 1556, no traces have been discovered, but it is not yet too late to hope for them, as the amount of retardation in its motion caused by the various planets is uncertain. No phenomenon has excited more interest than the remarkable meteor of Sept. 30th, which was seen throughout the New England States and in a portion of New York. The periodic meteors of August were as numerous as ever, while those of November were very few. The change in the proper motion of *a* Virginis, and probably of other stars, is a discovery fraught with interest both for the theoretical and the practical astronomer.

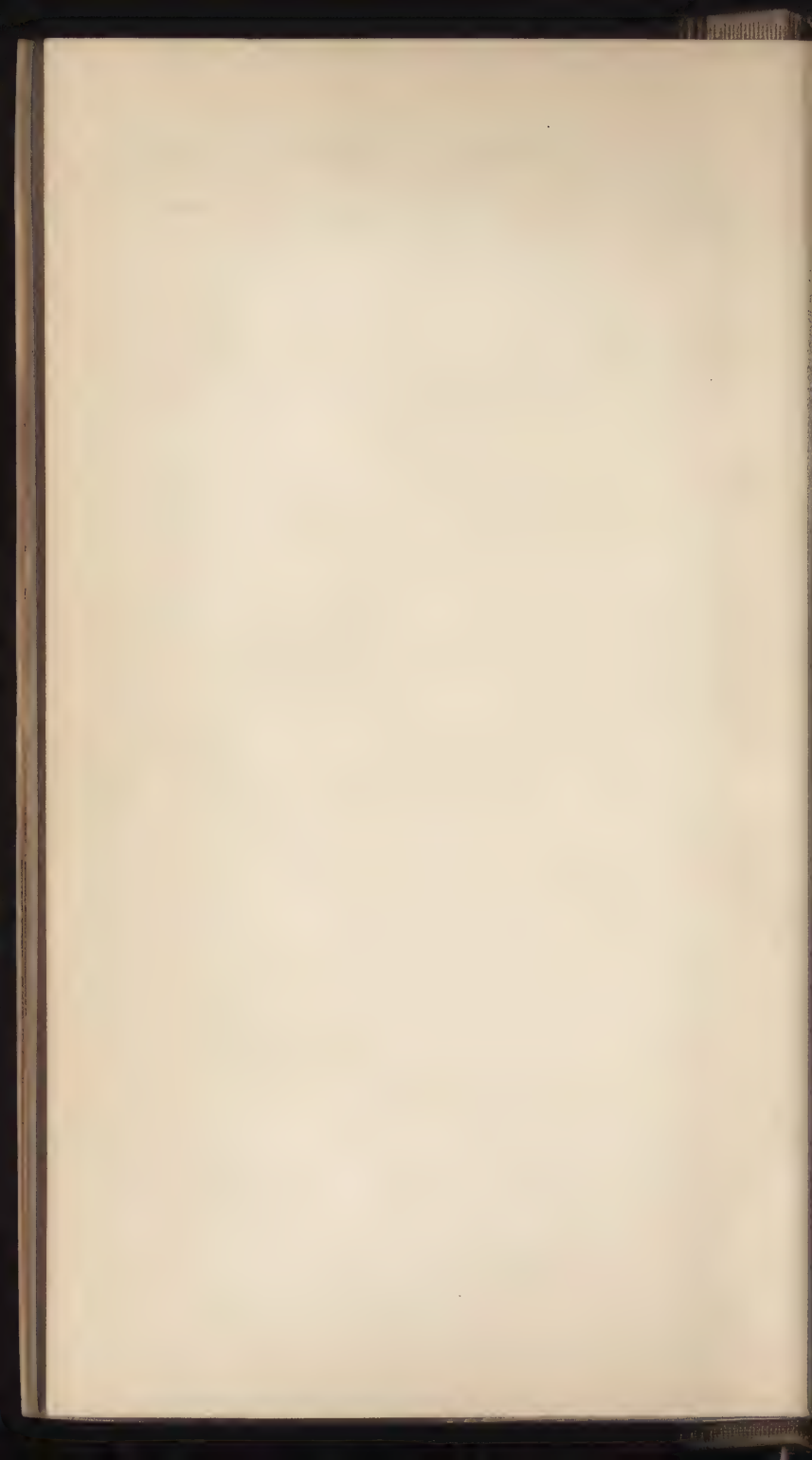
Only one new star has been announced in Europe, but we learn that the Messrs. Bond have detected three in the neighbourhood of the trapezium in the nebula of Orion, as well as a variable one, which appears and disappears at intervals of a few weeks. But, on the other hand, a reddish star observed by Mr. Hind in 1848, in the constellation of Ophiuchus, as of the sixth magnitude, and afterwards noted as of the fifth, seventh, and eighth magnitudes, could not be discovered when sought for by Prof. Loomis, on June 4, and it "may therefore be pronounced extinct."

Dove's maps of the isothermal lines of the globe must be regarded as a contribution of great value to meteorological science, however much opinions may differ as to the cause of some of the phenomena indicated.

Geographical science has been marked by the discovery of a lake in Southern Africa, by a careful examination of the Great Salt Lake, and an exploration of our Pacific coast. Much is expected from an expedition penetrating to Central Africa from the north, but the discoveries as yet announced are unimportant. A valuable contribution has been made to the antiquities of Central America by Mr. Squier, who has forwarded some of the results of his labors to the Smithsonian Institution. Layard continues his explorations at Nineveh with success.

The obituary of the past year includes the well-known names of Gay-Lussac, De Blainville, Beer, Kirby, Prout, Troost, and others, and as we write we hear of the death of Prof. Schumacher in the last week of the year.

It will thus be seen, that, though the past year has not been productive of any preëminently brilliant discovery, yet quite as much has been added to the amount of human knowledge as during almost any previous year.



THE

ANNUAL OF SCIENTIFIC DISCOVERY.

MECHANICS AND USEFUL ARTS.

COMPLETION OF THE BRITANNIA TUBULAR BRIDGE.

DURING the present year, one of the greatest works of modern engineering art, the Britannia Tubular Bridge,* has been brought to a successful completion. "As a matter of history," says the *London Times*, "a chronological summary of the structure will be interesting. On June 30, 1845, the bill sanctioning the construction of the Britannia Bridge was passed by Parliament. In July the preliminary experiments to determine the form of structure commenced; April 13, 1846, the first workmen were engaged on the bridge; April 21, first stone of the Britannia tower was laid; June 13, 1847, the first vessels arrived with iron at the Straits; August 10, the first rivet was inserted; February 22, 1849, the Caernarvon and Anglesey towers were completed; April, 1849, the pontoons were brought to bear; May 4, first tube was completed and platform cut away; June 20, first tube floated; June 22, last stone in Britannia tower laid; November 9, first tube deposited in permanent bed; December 4, second tube floated; February 7, 1850, second tube deposited on permanent bed; March 3, Caernarvon small tube lowered; March 5, first engine passed through tube, and last rivet inserted; March 18, single line of tube opened for public traffic; June 10, third tube of second line floated; July 11, third tube deposited; July 25, last tube floated; October 21, second line of tube opened for public traffic."

Before the bridge was allowed to be used for the conveyance of passengers and merchandise, it was subjected to very severe tests. "The first and principal experiment consisted in passing two locomotive engines through the tube, and resting them at intervals in the centre of the sections. At nine o'clock a train of twenty-eight wagons and two locomotives, with 280 tons of coal, was drawn into

* See *Annual of Scientific Discovery*, 1850, p. 15.

all four of the tubes, the deflections being carefully noted. These deflections, in every case, by means of a nice apparatus for the purpose, were ascertained to be exactly three fourths of an inch over the immense mass and area of iron. After an interesting rehearsal of these experimental ordeals, which occupied several hours, the train of 280 tons, with its two locomotives, was taken out about a mile distant from the tube, and then suddenly shot through it with the greatest attainable rapidity, and the result was very interesting, as determining a much-discussed question; it being found that the deflection at this immense velocity of the load was sensibly less, in the way of undulation or collapse, than when the load was allowed to remain at rest in the tube. The manner in which these results were registered and arrived at was by means of a new and curious contrivance, it being found that the tremor occasioned by trains in transit prevented these deflections from being accurately read by the ordinary spirit-level. This contrivance consists in a large pipe containing water, laid along the lower cells of the tube, one end rising up within the tube at the centre, and the other end fixed against the stonework of the abutments of the bridge. Both extremities of this pipe are furnished with glass tubes and graduated scales, by which the relative levels of the water are easily ascertained. As the slightest leakage or evaporation over the ordinary thermometric expansion of the water would derange the level, while only half the actual deflection of the tube was registered at each end of the pipe, these disadvantages are obviated by the addition of a large reservoir of water in the interior of the tube, which is covered with oil and placed beside the graduated scale. This larger area exhibits the whole of the deflections at the abutment extremity, and the apparatus presents a perfect mirror of all the deflections of the great structure.

"We learn from Messrs. E. and L. Clark, the resident engineers, who have watched minutely, from day to day, all the developed peculiarities of the novel undertaking, many curious and interesting results. These gentlemen state that the heaviest gales through the Straits do not produce so much motion over the extent of either tube as the pressure against the side of the tube of ten men; and that the pressure of ten men, keeping time with the vibrations, produces an oscillation of $1\frac{1}{4}$ inch, the tube itself making 67 double vibrations per minute. The strongest gusts of wind that have swept up the channel during the late stormy weather did not cause a vibration of more than a quarter of an inch. The broadside of a storm causes an oscillation of less than an inch; but when the two tubes are braced together by frames, which is now being done, these motions will be almost annihilated, and all apprehension from wind or weather, from their being secured together, will cease. The meteorological results since the tubes have occupied their elevation have materially differed from those that were observed when they lay along the Caernarvonshire coast. The action of the sun at midday, instead of bending them two or three inches, does not move them more than two or three eighths of an inch. The daily expansion and contraction of the tubes varies from half an inch to three inches, attaining either the maximum or minimum at about

three o'clock A. M. and P. M. These and other interesting results, as indicating the safe working of the great machine, are read by means of self-registering thermometers that record the constant temperature, placed in mahogany cases, protected by plate glass, and under lock and key. There is also a self-acting clock-work apparatus that elevates a shaft on a vertical plane, all the minutest motions of the tubes being delineated by an arm carrying a pencil, which is fixed to the tube. If a compass be held over any part of the bottom of the cells, the south pole is affected, and if held over the top of the cells, the north pole is affected, and this effect is observable in all parts of the tube, whether at the centre or end, although their position is only about 10° W. of the magnetic meridian."

Some of the acoustics effects produced by the bridge are curious. The report of a pistol fired beneath it is repeated three or four times. The cells of the top and bottom form excellent speaking tubes, and, by elevating the voice, persons may converse through the entire length of the bridge, more than 500 yards. If one end of the cells be closed they return a powerful echo; but, although a whisper is thus distinctly repeated, the loudest whistle does not appear capable of returning any echo.

REMINGTON'S BRIDGE.

A YEAR or two since considerable interest was excited by the publication of a letter detailing the struggles and trials of a young American in London, named Remington, who was striving to introduce a new bridge of his invention, for which extraordinary merit was claimed. Some doubt was afterwards thrown upon the whole story, but Mr. Remington has since returned to this country, and erected a bridge on his plan at Montgomery, Ala., which is thus spoken of:—"This beautiful structure, apparently too fragile to sustain its own weight, proves to be all that has been claimed. It was, immediately after the scaffolding was removed, put to the severest test. Hundreds of people passed over it, and it was conceded by the most skeptical that it would stand and answer for all practical purposes. The bridge, which at a little distance resembles a slight ribbon or shaving of wood, extended over a ravine beneath, four or five hundred feet in length, though looking as if it could not bear the pressure of a bird, is found to endure immense weight; in fact, it appears, all that can conveniently be placed upon it. The planks, which are at the abutment about six inches thick, fine away towards the centre to about one inch, or an inch and a half, and are finally joined by an impervious cement, the invention of Mr. Remington. The deflection in the centre is about ten feet."

The *Scientific American*, for July 20, notices a model of Remington's plan. It is 160 feet long, composed of four stringers, of a little over two inches square at the abutments, and tapering to about an inch square at the centre. It is of the form of an inverted arch. The stringers are made of several pieces of white pine, joined together by a scarf-joint, their ends, when they are joined, being bevelled at a

very slight angle, and the bevelled parts lapped over each other, and attached with glue. These joinings are so arranged that only one of them ever occurs in the same cross section of the bridge, and they are neither bolted nor clamped, but depend entirely upon the glue for their adhesion. Each of these stringers has about nine feet bearing on the abutments, to which they are firmly attached by iron bolts.

SUSPENSION BRIDGE AT NASHVILLE.

THE suspension bridge recently erected across the Cumberland River at Nashville, Tenn., is, according to the *Nashville Whig*, 672 feet long. The other dimensions are as follows:—Distance between the towers, 538 feet; width of superstructure, 28 feet; base of pier, 60 by 30 feet; height above low water, 110 feet. There are 16 cables, each composed of 200 strands of No. 10 wire. The whole work is calculated to bear a weight of 2,400 tons.

ARCH-GIRDER.

MR. JOHN BEVAN, of New York, has invented a "patent arch-girder for bridges, roofs of buildings," &c. As applied to bridges, it consists of a curved beam or girder, formed of two beams bolted together, with blocks between to keep open a space. Each beam is composed of leaves or plates of wood or metal of convenient length; these are firmly secured to each other, the outer layer of plates breaking joints with the inner layer. At the ends of the girder are fastened cramp-iron pedestals, in which pulleys work. On the top of the girder are also pulleys at short intervals. A wire rope passes over the girder, resting on the pulleys, is brought over those at the ends of the girder, and secured at the centre of the arch by clamps and a right and left hand screw. As the length of the rope is less than twice that of the girder, the latter cannot be straightened unless the rope is first broken. The recommendations of this bridge are its simplicity and lightness, the length of span of which it is susceptible, and the ease with which portions of it may be repaired without interrupting the use of the rest. — *Scientific American*, June 29.

ROTARY ENGINE.

MR. F. R. DELANO, superintendent of the Carondelet Mills at St. Louis, writes to the *Scientific American* for October 26, that in December, 1849, he went to Tyrees Spring, Tenn., for the purpose of examining a rotary engine, which had been in use there three years, the invention of Mr. J. A. Stewart. It consists simply in having two cog-wheels, running into each other, and so brought into contact with the caps and end-plates as to render them air and steam tight, without any packing. It is made entirely of cast-iron, except the pillow-blocks, which are lined with Babbitt metal. The steam is admitted from above, between the two cog-wheels, and is confined there by a cap and two cheek-pieces, which embrace the upper portion of the

wheel, so that the steam cannot escape without driving them. In its passage out from under the cap the steam may be conveyed to a second engine, and applied a second time. The wheels are kept in their place by perpendicular and horizontal set-screws, and by stationary guides. The engine at Tyrees Spring has steam wheels of 10 inches diameter from pitch circle, and 10 inches face; it has 10 cogs to each wheel, and the position they occupy is such as to give 20 square inches of effective surface. The boiler is a cylinder 20 feet long, 32 inches in diameter, carries steam at a pressure of 65lbs. per inch, and, with what fuel the mill makes (dust and slabs), cuts an average of 3,000 feet of oak lumber per day of twelve hours. What Mr. Delano saw induced him to put up a similar engine, to drive a single saw, in the mills under his charge. It is of the same size as that at Tyrees Spring, but the boiler is 22 feet long, 36 inches in diameter, has two 11-inch flues, and a pressure of steam of 60lbs. per inch. With saw-dust and half a cord of green slabs, 5,000 feet of inch-square edge lumber is sawed per day. It has been in operation three months, and it has not been necessary to clean the boiler out once. The only wear observable is in the Babbitt metal, and the arrangement for moving and adjusting the pillow-blocks is such that it is done while the engine is in operation.

IMPROVED OSCILLATING ENGINE.

MR. JAMES WYLIE, of New York, has in operation an improved oscillating engine. It is of 6-inch bore in the cylinder, and 12-inch stroke. It employs no valve-rod, and, strictly speaking, the only valve about it is the throttle-valve. The cylinder is horizontal, vibrating on trunnions, and on its top is a spherical projection, smoothly planed on the face, hollow, and it has two openings into the steam passages, leading into both ends behind the piston. The steam-box has three openings, two for the exhaust, and one for the steam. This box is fixed and is concave on the under side to fit like a cap on the central spherical projection of the cylinder. When the cylinder vibrates, it opens communication with the exhaust and steam passages alternately, thus dispensing with the use of the slide-valve. It is a good improvement, as it has fewer parts than the common engine, and avoids all loss by back pressure on the valves. — *Scientific American*, Aug. 3

DOUBLE-PISTON STEAM-ENGINE.

IN this machine of M. Paltrineri's, the steam-cylinder has two pistons, which move in opposite directions; a single valve-box suffices to lead the steam at one time to the middle of the cylinder, when the pistons are to be driven outwards, at another to the ends, when they are to be driven inwards. The author points out various applications of this system for locomotives, and for steamships of great power, and he has succeeded in some of them in making very simple arrangements, which allow the reduction of the dimensions and weight of the apparatus. — *Recueil de la Société Polytechnique*.

NEW MARINE ENGINE.

EXPERIMENTS have been made in New York, under the inspection of Mr. C. H. Haslet, Engineer of the Navy, with a boat fitted with a new engine, called the "pulley-engine." Two boats were constructed, each 50 feet long, and as nearly alike as possible, with water-wheels of the same size, and boilers with cylinders of the same bore. One of the engines was constructed upon the usual plan; the other upon a new plan, which is the invention of Mr. Yates, of Milwaukee. In all the experiments the Pulley (so called from its engine) rapidly left the other (the Crank) behind; and it would appear that, with a cylinder of 48-inch stroke, the pulley-engine is capable of turning the same sized wheel as the crank-engine, faster than the crank with *two* strokes of 32 inches each. The crank, therefore, using one third more steam to each revolution than the pulley, the pulley is entitled to make one third more revolutions than the crank, to equal the consumption of steam. The value of one third more revolutions to the same amount of steam in the marine engine is an advantage, which, if attainable, our engineers will not fail to appreciate. This improvement is also believed to be superior for marine purposes, on account of its constant and uniform leverage at every point of the revolution, and its entire revolution at every stroke of the piston. — *New York Tribune*.

APPARATUS FOR STOPPING STEAM-ENGINES.

THE object of this invention is to enable the superintendent of machinery, situated at a distance from the steam-engine, to stop its action and momentum instantaneously, without the necessity of communicating with the engineer. For this purpose, the patentees, Messrs. Donisthorpe and Milnes, propose to employ, in low-pressure engines, a pipe, which opens into the condenser at the bottom, and communicates with the atmosphere at the top. This pipe is opened and closed by a cock, placed in the upper part of it, on the spindle of which there is affixed a weighted lever. When the pipe is closed, and a vacuum established in the condenser for working the engine, the weighted end of the lever is supported in a horizontal line by a sliding plate, on which the weight rests. The other end of the sliding plate is attached to a bell-crank lever, to which wires are connected, which are carried into different apartments, where the machines are placed, and there provided with pulls; so that, to stop the engine, it is only necessary to move the pull, which will cause the sliding plate to be withdrawn from under the weighted end of the lever, which will then fall down into a vertical position, open the condenser to the air, thus destroying the vacuum and stopping the machine. In a high-pressure engine some changes in the mode of application are necessary. Means are adopted to prevent the engine from being wantonly stopped. — *London Mining Journal*, May 26.

BOILER TUBES.

MR. JAMES BANNISTER has received a patent for some "improvements in tubes for locomotive and other boilers," which relate to the making of the tubes by the combination into one of three tubes of different metals, and to a mode of manufacturing tubes of copper, brass, and other alloys of copper. In the first part of the invention, three tubes of different metals are employed, brass, iron, and copper being the metals. These tubes are placed one within the other, the brass tube on the interior, the iron next, and the copper on the exterior. A slightly tapering mandril is then introduced, and the tubes are drawn through a series of dies till they are closely combined. By this mode of construction, the advantage is obtained of having the beneficial results consequent on using brass where the rush of flame comes, together with the advantage of having the copper next the water, while the whole is stiffened by the iron. When, however, the fire is to act externally, the order of arrangement should be reversed.

The second part of the invention consists of a new means of joining the seams of tubes of copper, or brass, and other alloys of copper. The metal is to be bent over into the form of a tube, so that the edges come together, and then, by the edge of a triangular file, remove the edges of the metal, so as to form as it were an angular gutter. The tube is then filled with sand, and the exterior covered with it, leaving a gutter in the sand so as to increase the size of that made by the coming together of the chamfered edges of the metal, and in this condition the tube is heated to a bright-red heat. Melted metal, similar to that used for the tube, is then poured into the gutter, which will partially fuse the edges of the tube, and then the whole will set into a solid mass. When it is cold the projecting ridge of metal at the seam is removed. This is best done by passing it in contact with a circular saw. The tubes thus made are passed two or three times between grooved rollers, having a mandril in them, and are then completed by drawing through dies with a mandril, as is usually done with other tubes. — *Civil Engineer and Architect's Journal, July.*

SAFETY-VALVE.

AT Messrs. Stonehouse and Co.'s office is being exhibited a new invention to be applied to steam-boilers. From the hollow standard of the float-pulley, near the boiler, springs a short elbow-pipe, the upper orifice of which is a small safety-valve; and from the chamber on which it works rises a tube, terminating with a whistle. The valve is held down by a lever and weight, the fulcrum of the lever being a short standard on one side of the valve. But the lever is prolonged backwards also, passing through a slant in the main standard, and terminating in an eye, which loosely embraces the float-rod. On the valve-box there is a second small standard, opposite the one forming the lever, projecting backwards, and also embracing the float-rod. This second lever is likewise jointed to the safety-valve rod, but there is no weight on it. On the float-rod, and between the eyes of the two

levers, a tappet is screwed, so that when the water gets too low it presses the lower lever, and when too high it elevates the upper one; but in either case the safety-valve is lifted and the whistle sounded. The same alarm is given when the steam is too strong. — *North British Mail*.

SAFETY-VALVE AND SIGNAL. — A patent has been taken out for a new arrangement of valve for the boilers of steam-engines, &c., which not only performs the functions of an ordinary safety-valve, but gives notice, by a loud signal, whenever the level of the water in the boiler deviates from its proper limits, or in case of the safety-valve becoming inoperative, by adhesion or any other cause. It consists of a standard, which is tubular at the lower part; on the top of this is a pulley, over which works a chain, connected at one end to a float in the boiler, while to the other hangs a balance-weight. From the bottom of the standard projects an elbow-pipe, on the top of which is a chamber, containing the safety-valve, and connected with a powerful steam-whistle. The valve-rod is acted on by a weighted lever, the fulcrum of which is on one side, and also by another acting in an opposite direction. The ends of these levers are elbowed, and the rod from the float within the boiler passes through them, having a tappet on it midway between them, which, being either raised or depressed by any fluctuation of water in the boiler, or in case of the float becoming detached, acts against one of the lever ends, and thus raises the valve and sounds the whistle. There is a graduated plate with an index-hand on the pulley, acting as an indicator. When the steam attains too high a pressure, the valve is acted on in the usual manner. Though this patent is recent, this new apparatus has already been very extensively introduced. — *London Mining Journal*, Aug. 24.

REGENERATIVE CONDENSER.

At the meeting of the Society of Arts, on May 15, Mr. C. W. Siemens described a new condenser of his invention. It consists of a series of copper-plates $\frac{3}{32}$ inch thick, $4\frac{1}{2}$ inches broad, and 2 feet long each, which are piled together with two longitudinal flattened copper wires, and the whole pile is screwed tightly together between the sides of a rectangular closed vessel, which constitute the body of the condenser. The ends of the plates project through the top and bottom of the vessel, and are made flush with its exterior surfaces; after which a ring of India-rubber is laid on, which is screwed down with a bonnet. The flattened wires between the plates stand about three inches apart, and form with them a large number of narrow passages, through which the cold, condensed water flows in an upward direction; while their outer edges project into the vacuous space of the condenser, and form the condensing surface.

Encouraged by the success of this condenser, Mr. Siemens has directed his attention to the achievement of a more important object, which is to condense the steam in such a manner that the condensing water issues into the hot well at boiling heat, and yet produces an efficient vacuum within the working cylinder. This he has accom-

plished by a new principle, which he calls "the regenerative principle of condensation." The regenerative condenser, as applied to a high-pressure engine, consists of an upright rectangular trunk of cast-iron, the lower end of which assumes the form of a cylinder, and contains a working piston. The trunk itself contains a set of copper or brass plates, placed upright and parallel to each other, with a space between them of the same breadth as the plates, or from one twelfth to one sixteenth of an inch. The upper end of the condenser communicates on one side with the exhaust part of the engine, and on the other with a hot well through an uncovering valve. The plates are fastened together by thin bolts, with washers to keep them apart. Directly below the plates a cold-water jet enters the condenser, whose action is as follows:—Motion is given to the piston by the engine, causing it to effect two strokes for every one of the engine. At the moment the exhaust part of the engine opens, the plates are completely immersed in water, a small portion of which has entered the passage above the plates, and is, together with the air present, carried off by the rush of steam through the valve into the hot well, where the water remains while the excess of steam proceeds into the atmosphere. An instant later the water recedes between the plates, exposing first their edges to the steam, which condenses thereon, and, being still of atmospheric pressure, heats them to nearly 212° F. But, in proportion as the remaining steam becomes expanded, additional and colder portions of the plates are exposed by the receding water. At the time the water-level sinks below the plates, the greater portion of the steam is condensed, its lateral parts being deposited in the plates, which are heated at their upper ends to 210° , and at the lower to about 140° . The remaining steam is thereupon condensed by the cold jet. The communication is completed before the working piston has accomplished one seventh part of its stroke. In reascending, towards the end of the stroke the water absorbs the heat from the plates in the same successive manner, and issues into the upper passage nearly boiling hot, when it meets with the succeeding discharge of the cylinder, and is carried off into the hot well, as described. The advantages obtained by this condenser are the allowing a portion of the steam to escape uncondensed, and the condensing the rest with a minimum of condensing water. The escaping steam may be used to create a draught in the chimney, and the hot water partially to supply the boiler, thus saving ten per cent. of the fuel. No power is abstracted from the engine; it is cheaper and more compact than other condensers, and is easily attached to low or high-pressure engines. Mr. Robert Stephenson strongly commended the invention, but doubted its applicability to locomotive engines.—*London Mining Journal*, May 19.

PIRSSON'S FRESH-WATER CONDENSER.

At the meeting of the Franklin Institution, May 17, Mr. B. H. Bartol made some interesting remarks in relation to Pirsson's fresh-water condenser, now in use on board the steamer Osprey. The pecu

liar feature of this condenser is the placing of the condensing tubes horizontally within the ordinary shower condenser, which is made large for the purpose. By this arrangement the water required for condensation is admitted through the ordinary injection-cock, and rises to the top of the external condenser, where it is discharged on a scattering-plate, whence it passes directly on to the tubes of the internal condenser, which are arranged below it in three ranges or sets, one above the other; the steam from the cylinder is admitted into the upper range, and passes through the three before being discharged at the bottom. The fresh water produced by the condensation of the steam is pumped out by a small pump and immediately returned to the boilers, while the water used to produce condensation is taken out by the air-pump of the engine. The internal condenser is not attached to the external one, but merely laid in it. The three ranges are separately made, and the outlet from the upper slips loosely into the one below it, so that when the whole internal condenser is together, it may be moved from an eighth to a quarter of an inch in any direction, thus preventing any liability to fracture from unequal expansion, and the tubes being in a vacuum relieves them from all pressure. As the condensing water reaches the bottom of the tubes, it is pumped out, so that there is not at any time any water around the tubes other than the thin sheet passing over their surfaces. On the Osprey the vacuum within the tubes of the internal condenser is 26 inches, and the same in the external one, the internal vacuum being the result of condensation, while the external one is produced by the air-pump. In three voyages, of 2,750 miles in all, no trouble has been experienced in keeping a full supply of fresh water in the boilers. — *Journal of Franklin Institute*, June.

SPHEROIDAL STATE OF WATER APPLIED TO MACHINERY.

A CORRESPONDENT of the *New York Tribune* states that M. de Beau-regard has erected in Paris a steam-engine of 500 horse-power, in which he takes advantage of the spheroidal state of water.* Instead of the common boiler with its tubes, he uses a single vessel with a flat bottom, about one fiftieth as large as an ordinary boiler of the same power. It is inclosed in a brick furnace above a fire-grate of reduced dimensions. This vessel is always without water; and connected with its bottom are two thermometers, and on the cover is a valve, which, on being opened, instantly stops the engine. The bottom of the vessel or boiler is kept at a temperature of 750° F., and the principle of the machine is, that, when a small quantity of water is cast upon a surface heated to 750° or more, it is reduced to steam, which remains at the same temperature. To use the engine one or two cubic inches of water are thrown into the hot vessel, and are, of course, reduced to steam, which is so expanded as to occupy the entire vessel, when it begins to set the piston in motion. After this the engine itself supplies the boiler with water. The steam leaves the

* See *Annual of Scientific Discovery*, 1850, p. 196.

cylinder at a temperature of 580° , and, passing through the water-reservoir of a coil of pipe, heats that water to 202° before escaping into the air or being reduced to water. This engine has been worked for three months, and the result of various experiments are, an economy of fuel of over 50 per cent., a reduction in the weight of the machinery of the same amount, and security from explosion.

MEANS OF PREVENTING THE CORROSION OF STEAM-BOILERS.

A WRITER in the *London Artisan* for December, 1849, proposes to effect the prevention of the corrosive action exerted by the water on the interior of boilers, by applying over the whole of the inside a thin coat of varnish, of such a nature that, while it would remain unaffected by the high temperature to which it would be exposed, it should offer no serious resistance to the regular transmission of heat from the iron to the water. To effect this object, he proposes to pour a small quantity of coal-tar into the water just before the steam is to be got up. This substance possesses the singular property, when thrown into boiling water, of parting with its volatile portions, and diffusing the remainder of its substance, as a hard insoluble pitch, all over the interior of the vessel, thus accomplishing the object desired.

NEW SALINOMETERS.

THE importance of having some means of determining the exact density of the water in the boilers of marine engines, at any moment, is universally recognized. To effect this end various "salinometers" have been invented, but a new one, by William Sewall, jr., U. S. N., will probably be found the most efficient yet produced, from its convenience, little liability to clog, and the possibility of placing it in any desired position. It consists of a cylindrical brass chamber, permanently attached in a vertical position, having on its side near the bottom two cocks, with pipes leading into the boiler, the one directly over the furnace-crown, the other near the bottom of one of the "legs." Either may be used, as desired, but the first is that generally employed. An outlet-pipe leads from the bottom of the chamber, furnished with a cock, below which enters another pipe, whose mouth or upper end is about half an inch below the top of the chamber; this forms an overflow. A Fahrenheit thermometer, attached securely to the inner side of the chamber, and an hydrometer, graduated for saline solutions containing from $\frac{1}{33}$ to $\frac{12}{33}$ (the latter being the point of saturation), sliding freely in a guide for steadiness, complete the apparatus. When in use the first cock to the boiler is always partly open, while the overflow carries off the water as fast as it enters; but when it is desired to test the density, this cock is shut, until the water has cooled to 200° F., when the hydrometer is read off and the current re-established, thus preventing saline deposits in the pipes. — *Journal of Franklin Institute, July.*

MR. MATHER has introduced a self-acting and discharging salinometer, which consists of a brass brine-receiving cylinder, fixed on the

outside of the boiler, below the water line. In this is a cylindrical hollow float, having a vertical piston-rod at the top and bottom, to each of which is attached a plug or piston, fitting into corresponding circular apertures in the top and bottom of the brine-cylinder, connected with the blow-off pipe. When the water in the brine-receiver is below the limited standard of density, the float sinks to the bottom, closing the lower orifice, but, as the density rises, the float is raised, and a portion escapes. There is on the top of the receiver a glass index-tube, in which a wire attached to the float-rod rises and falls, indicating to the attendant what is going on within the boiler. — *London Mining Journal*, Sept. 28.

SEA-STEAMERS BUILT IN THE UNITED STATES IN 1850.

AFTER various unsuccessful attempts at building rapid sea-going steamers, there have at last been completed some American steamships, which, in point of speed and regularity, must take the highest rank. During the past year four of the vessels of the New York and Liverpool line of steamships, owned by E. K. Collins and others, have commenced their voyages. They are called the Atlantic, Pacific, Arctic, and Baltic. As they are much alike, a notice of the dimensions of the Atlantic will suffice for all. She is 290 feet long on deck; 46½ feet beam; 32 feet depth of hold; 3,300 tons carpenter's, and 2,900 tons custom-house measurement. The interior decorations are of the most costly character. The cost of each vessel was about \$600,000. The speed of these vessels is evidently very great, the average of their passages being considerably less than that of the new Cunard steamers, which are a great improvement upon the old vessels of the same line. One improvement has been introduced into the Collins steamers, which is calculated to add much to the comfort of passengers. It consists in warming every part of the ship by means of steam-pipes supplied directly from the boilers.

The *Journal of the Franklin Institute* for October gives a list of all the sea-steamers built or building in the United States during the year 1850. The total tonnage is 42,097 tons. The four Collins (Liverpool) steamers make 12,000 tons; two Havre steamers, 4,100 tons; twelve for the Pacific, 13,232 tons; eleven, intended to run coastwise in the Atlantic and Gulf of Mexico, 9,765; two to Liverpool, 3,000. The total number of vessels is thirty-one; of which seven, with a tonnage of 5,925 tons, are propellers.

NEW MODE OF APPLYING STEAM TO THE PROPULSION OF VESSELS.

MESSRS. RUTHVEN, the well-known engineers of Edinburgh, have invented a new mode of applying steam to the propulsion of vessels. The arrangement consists in the forcible expulsion of water from a nozzle, or bent pipe, at each side of the vessel, which is effected by the power of the steam-engine. The form and properties of a sailing vessel are preserved, there being no projections on the hull in the form of paddle-boxes or otherwise. Under the engine, which is

placed in a horizontal position, is a round iron case, in which there is a wheel, having a shaft through a stuffing-box, on the upper or outer side. The piston of the steam-engine is attached to the shaft-cranks, and the steam-power is applied wholly to revolving the wheel in the iron case, which, being made something like a fan-wheel, carries the water with it in its revolutions. The water, in obedience to the laws of centrifugal motion, presses towards the outer rim of the case with a force proportionate to the speed, and escapes by an aperture and pipe at each side, whence it is discharged by the nozzle into the sea. The water is supplied to the iron case by a large, flat pipe, which has a free communication with the sea by means of apertures in the bottom of the vessel. The nozzle is above the water-line, and can be turned by the seamen on deck with the greatest facility, so as to discharge the water either towards the bow or stern. Discharging the water astern makes the vessel go ahead; when discharged towards the bow, the vessel goes astern; and when discharged downwards the vessel remains stationary. These operations are effected without the engine being altered or stopped,—a material improvement on the paddle-wheel; and as the elevation of one nozzle is rapidly altered, independently of the other, ample facilities are given for turning the vessel. The absence of obstruction on the hull enables the vessel to use sails with as much effect as a common sailing vessel, while the steam-power may be perfectly combined with the action of the sails,—an advantage denied to a steam-vessel, except to a limited extent. — *Edinburgh Evening Courant*.

IMPROVEMENT IN MARINE PROPULSION.

MESSRS. JOHNSON, CAMMELL, & Co. have exhibited an improvement in the machinery for propelling steam-vessels. The propellers hitherto in use have been invariably made from cast metal, and, when at rest or in motion, are a perfect screw, always at the same pitch. The improved flexible propeller to which we refer is made of steel, well hammered and tempered, and set at an angle on the revolving shaft. When at rest it is a perfect plane, but when in action it forms a screw, and, by the flexibility of the steel, assumes a finer or a coarser pitch, according to the strength of the adverse action of the water through which it moves. This circumstance imparts to the vessel and machinery an easy action, especially in rough and heavy seas, which has never been attained by the rigid screws now in use. Propellers manufactured according to this patent are not more than half the weight of those made of cast metal, though the forgings are the largest yet attempted to be made from steel. It has been ascertained by experiment that, in point of speed, there is a gain of at least twenty per cent. In heavy seas or rough weather this propeller can be easily hoisted on board, by means of a simple block and tackle, thus saving the expense of the machinery now used for raising the cast metal ones, and, from being malleable and tough, it does away with the risk of breakage, which necessarily ensues in the moving of a cumbersome piece of cast metal. In cost there is a saving of about fifty per cen

Four of these propellers have already been made and brought into use; and, as a proof of the high estimation in which they are held, it may be stated that the Lords of the Admiralty have ordered her Majesty's yacht, the *Fairy*, the swiftest screw-vessel afloat, to be fitted out with one of them in preference to the rigid screw. — *Sheffield (England) Times*.

PROPELLER FOR CANALS.

ANOTHER invention for adapting steam to canal navigation has been brought out by Mr. O'Regan. The boat resembles in size, shape, and general appearance, the ordinary fly-boats employed on our canals, which have hitherto been worked by horses only. The steam is generated by a vertical tubular boiler, to which an engine of six horse-power is attached. The cylinder is five and five eighths inches in diameter and of ten and a half inches stroke, the pressure being fifty pounds to the square inch. A screw, two feet four inches in diameter, and consisting of two arms, is mounted in the stern, immediately behind the rudder; attached to which is a horizontal axle of considerable length, passing longitudinally through the bottom of the boat, as near the keel as practicable. A driving band, worked by a large wheel, causes this axle to revolve with great rapidity, — ninety revolutions being produced in each minute, and four times as many revolutions of the screw. The chief peculiarity is the position of the axle and screw, the former of these being placed extremely low down, so as to enable the screw to work at a considerable depth in the fluid, an arrangement which materially augments the propelling power, and at the same time causes as little commotion as possible in the upper stratum of the water. This boat has been propelled at the rate of five miles per hour. The space occupied by the engine is only three feet four inches by two feet six inches, and the width of the boiler is about three feet. The engine consumes eight hundred weight of coal per day, and the entire cost of the propelling, inclusive of fuel and the wages of the enginemen and firemen, is, according to Mr. O'Regan's estimate, only 4*d.* a mile, while the cost per mile, where the motive power is supplied by horses, is no less than 1*s.* 9*d.* — *Saunders' News-Letter*.

A steamboat intended to accomplish the same purpose has arrived at Trenton, New Jersey, and is described in the *State Gazette*. She has but one large paddle-wheel, which is placed in the centre of the boat, and the paddle-boxes are so constructed as to hold the water when they enter it, and prevent it from escaping sideways. The water is thus drawn from the front and sides of the boat and thrown out at the stern, so that the boat makes no swell. She has one boiler and two engines, and can, it is said, tow boats containing one thousand tons of coal at the rate of three miles an hour.

PERPENDICULAR AND RADIAL PADDLE-WHEELS.

AT the close of an elaborate investigation, in the *Journal of the Franklin Institute*, of the comparative merits of the perpendicular and

radial paddle-wheels for sea-going vessels, B. F. Isherwood, Chief Engineer of the United States Navy, concludes that, "for vessels of a medium size and a nine days' voyage, the perpendicular paddle-wheel possesses decided advantages over the radial paddle-wheel, economically, potentially, and in view of the practical advantages of less strain upon the machinery and ship." The correctness of this conclusion has, however, been disputed by others, in later numbers of the same journal.

ENGINE FOR STREET LOCOMOTION.

THERE is now in operation upon the Hudson River Railroad, for drawing the cars through the city, a double condensing engine, so constructed as to make no noise and emit no smoke. On the outside it resembles a baggage-car, all the works being inside. It has two cylinders of twelve-inch diameter and eighteen-inch stroke. It condenses its steam, but can be immediately converted into a non-condensing high-pressure engine, if required. It carries a tank of water sufficiently large for the trip from Thirty-first Street to Chamber Street, and, of course, there is no puffing. It burns coke and uses a blower, so that no smoke, sparks, or chimney are visible. It works quietly, and has thus far proved itself capable of drawing a train of eight cars with the utmost ease, at the cost of only a few cents per trip for fuel. — *Scientific American*, Aug. 3.

OSCILLATION LOCOMOTIVE ENGINES.

At the meeting of the Society of Arts, on Jan. 30, Mr. George Heaton read a paper, "On the cause of the oscillating motion in locomotive engines at high velocities, and a method of correcting it." When a man walks upright, on placing his right foot forward he throws his right hand in the same direction, and his left arm backwards, and when the left foot is advanced the left arm follows its direction and the right goes back. This counteracting motion, which comes instinctively, keeps the body upright, and the author has endeavoured to apply this principle to prevent transverse oscillation in locomotives, from the effects of which they are frequently thrown off the track. He illustrated his remarks by a working model, which was driven at a velocity of forty-two miles per hour, and the oscillation, evidently taking place from the unequal concussion of the pistons at the dead parts of the stroke, was so great as to cause the frame-work to vibrate transversely some two or three inches from its position at each end alternately, as if turning backwards and forwards on a central pivot. Experiments were then shown with the wheels weighted on one side to balance the force of the crank-motion, which had some effect at a moderate speed, but did not cure the oscillation at the highest velocity. It will be found when an engine of twenty-inch stroke, with six-foot driving-wheels, goes fifteen strokes per minute, or three miles per hour, it requires one tenth of the weight moving along the horizontal line (that is, the piston and gearing moving

backwards and forwards within the engine-framing), to stop it and turn it again; at thirty-five strokes per minute, or about seven miles per hour, one half its weight; at seventy-four strokes, or fifteen miles per hour, one and a half times its own weight; and at twenty miles per hour, four times its weight.

Mr. Heaton's improvement consists in connecting to an auxiliary crank-pin, a rod of similar length with the piston-rod, on the other end of which is a pulley, working between guide-rods placed on the opposite sides of the axle to the cylinders, thus obtaining a counteracting force, preventing concussion. The weight must be equal to the piston and its gearing, so as to make the weight run to the left hand at the same instant the piston goes to the right; the blow to stop the piston, and make it return at each end of the stroke, will be received in the auxiliary crank, instead of in the wheels, producing a neutral point in the centre, and steadiness of motion; for, when the blow is received in the wheels, the cranks being at right angles, it is communicated through the axle, and gives a twisting motion to the whole framing of the engine; this being repeated with regularity produces an effect similar to rocking a boat; this oscillation is found to be greatest when the engine is running most regular for speed, and the piston going the same way with the oscillation of the carriage. The effect of this counteracting motion, when in operation, was so great, that not a tremble could be detected in the model. — *London Mining Journal*, Feb. 2.

LOCOMOTIVE FOR ANTHRACITE COAL.

THE *Scientific American* for Sept. 7 commends very strongly a new locomotive for burning anthracite coal. Its qualities have been tested on the Reading and Hudson River Railroads. A speed of forty miles per hour has been attained, but it is its merit as an engine for burning anthracite coal, without smoke or sparks, that is particularly praiseworthy. The construction of the boiler is peculiar. The fire-box is entirely surrounded with water, and there is a series of horizontal copper tubes inserted in a back plate, connected with a back-water chamber at the front end, and these run forward, and are bent up in the fire-box, inserted into and projecting above the crown-plate. In this way there is no waste of heat and no destructive action of the fire upon the tubes. The bent part of the tube allows for the expansion and contraction of the metal, and there is a pump inside, worked by a rod from the engine, to keep up a continual current through the whole boiler.

NEW TANK LOCOMOTIVE.

A NEW locomotive of a somewhat novel construction has been placed on the Newcastle and Berwick line. Its principal feature is, that it carries its own supply of coke and water, without the necessity of a tender; which is done by two tanks, one placed under the footboard and the other under the boiler. It carries sufficient coke for a run of

seventy miles, and water for thirty miles, and is arranged to run with either end first. It is intended to run with light trains on a short branch line. — *London Mining Journal*, March 9.

COMPARATIVE VALUE OF COAL AND WOOD FOR LOCOMOTIVES.

A REPORT on some experiments made on the Boston and Maine Railroad, for the purpose of testing the relative values of anthracite coal and different kinds of wood for fuel in locomotives, has recently been published by the New England Association of Railroad Superintendents. The engines used were the "Coaler," built by Winans of Baltimore, and the "New Hampshire," a wood-burning engine, built by Hinckley & Drury of Boston. The experiments were conducted by Messrs. Slade and Currier. The results obtained are as follows: — The average quantity of station-wood required to evaporate 3,500 gallons is 3.45 cords; average quantity of anthracite coal, 2.15 tons. 215 tons of coal are therefore equal to 345 cords of station-wood, or one ton of coal equals 1.6 cords of wood. The average cost of fuel for carrying 15,000 tons of freight one mile, when the trips are over the entire road, is, for wood, as shown by nine trips, \$14.04; for coal, as shown by seven trips, \$12.70. Difference in favor of coal, \$1.34. When the engine runs only between Boston and Haverhill, \$1.41 is to be added to the cost of wood, thus increasing the difference in favor of coal to \$2.75. Comparing those trips in which the engines are on a par as regards the evaporation of water, the average cost of evaporating 3,500 gallons is, with wood, \$12.44, with coal, \$11.26. Difference in favor of coal, \$1.18. Additional cost of wood, if run only between Haverhill and Boston, \$1.41, increasing the difference in favor of coal per day to \$2.59. Comparing those trips which put the engines on a par as regards the size of the load, the average cost of carrying 15,000 tons of freight one mile is, with wood, \$14.92, with coal, \$11.84. Difference in favor of coal per day, \$3.08, or, if run between Haverhill and Boston, \$4.49. The average cost of wood, when the trips are over the entire road, is \$3.63 per cord; when from Boston to Haverhill and back, \$4.08. Cost of coal, \$5.25 per ton. As regards speed, that of the Coaler on an average is 14.3 miles, of the wood engine 14.1 per hour. Difference in favor of coal, .2 of a mile. The coal left in the Coaler after the trip is finished is considered as balancing the wood used in kindling.

The general result is, "that anthracite coal used for fuel in locomotives on railroads, where heavy trains are run, is superior to wood in point of economy."*

FORM OF RAILWAY AXLES.

AT the meeting of the London Institution of Civil Engineers, on March 26, Mr. Thorneycroft detailed a series of experiments which he had made upon the strength of railway axles. His conclusions

* See *Annual of Scientific Discovery*, 1850, p. 39.

may be summed up as follows:—With regard to the forms of railway axles, it appeared to him, he said, from the experiments, that the nave of the wheel should not be placed close to, but at some little distance (say three fourths of an inch) from, the neck of the journal; also, that the shoulder behind the wheel should be entirely done away with; and, instead of reducing the diameter of the axle in the middle, it would be advisable rather to increase the bulk at that point, like the connecting-rod of an engine. He had never heard of a single case, in which the texture of a fractured parallel axle had been found changed from a fibrous to a granular character, although a certain amount of granulation had been repeatedly observed with axles which had been reduced in the middle, and had then been broken in course of regular working. It appeared in all such cases as if there had been a progressive and alternate action of compression and extension of the outer fibres, from the bending of the axle, whilst it was rotating; and that thus the granular fracture had been produced. If a shoulder was left on an axle, it should be curved; for if it was left square it would induce fracture at that part. It would appear that there was a constant progressive tendency to fracture, wherever opportunity was afforded for its commencing. Now a parallel axle did not afford any spot for the commencement of fracture; on the contrary, the fibres extended unbroken throughout the length of the bar; and, unless, from the undue weakness of the axle, a constantly recurring bending action occurred, by which the whole external fibres were compressed *serialim* as the axle rotated, there could be no tendency to break.

IMPROVED BRAKE.

MESSRS. KIMBALL & RICE, of Concord, N. H., have patented an improved brake, which has been in use for some months upon several of the cars on the railroad from Concord to Boston, and has given great satisfaction. The invention consists in placing a tube-coating of India-rubber around a link passing through a box or casing, which is attached to the brake. The rubber is inclosed in the box, to hold it in a permanent position, except so far as its elasticity is affected by the pressure of the link, whenever the brake is used, thereby causing the rubber to act and react within itself without any rubbing or friction of the links in which it is inclosed, thus avoiding the wear and rattling of the machinery, as well as unpleasant shocks — *Scientific American*, June 15.

RAILWAY WHEELS.

MR. E. CHAMBERS, of Birmingham, has received a patent for some "improvements in the manufacture of wheels." The wheels are each made up first into halves, each half consisting of one half of the ring or felloe, one half of the spokes, and one half of the nave, all of wrought-iron, and the several parts are made as follows:—For each half of the nave a block or plate of iron is forged in a cylindrical exterior frame, with a flange or projection all round, which flange is to

be drawn out by forging, so as to form projecting pieces at those parts of the circumference where the spokes are to be welded on. There must necessarily always be an even number of spokes, so placed upon the half-naves that those of the one half shall come into the spaces between those of the other half. The projections or flanges having been drawn out, the spokes are to be welded on, each one having a portion of the felloe welded thereon, the alternate portions being on the half-naves respectively. The halves are to be brought to a welding heat, and then welded together by a suitable hammer or press ; after which the centre of the nave is to be cut out to receive the axletree. — *Civil Engineer and Architect's Journal*, June.

AUTOMATIC REGISTER OF THE SPEED AND OF THE TIME OF STOPPING OF RAILROAD TRAINS.

UNDER this name, M. Breguet submitted to the French Academy, on Dec. 17, 1849, an instrument intended to exhibit the speed of trains on railways at all points, as well as the time passed at each station where the train stops. His machine consists of three parts ; a clock-work wheel, one of whose axles bears a "helix curve," which revolves in an hour, or in any fraction of an hour ; this helix causes a pencil to move perpendicularly from below upwards ; a paper band of any length ; an endless screw, whose axle carries a pulley at its outer extremity. This screw gives motion to a wheel, the pinion of which teeth into a second wheel, mounted upon an axle, which carries a cylinder designed to move a band of paper. The machine being placed upon the tender, or upon a car, a pulley is put upon one of the axles of the wheels, and, a cord being passed over this pulley, as well as over that of the machine, the screw will turn, if the car moves, and the wheels and the cylinder, and consequently the band of paper, will be set in motion. Thus there are two distinct motions, independent of each other, the one horizontal and variable (that of the paper band), and the other vertical and uniform (that of the pencil). By means of these two movements we have a winding curve, the abscissas of which represent the space passed over, and the ordinates the time passed. In the machine exhibited, the relation between the cylinder and the pulley is $\frac{1}{300}$, the diameter of the cylinder 6 centimetres ; consequently 300 revolutions of the pulley will represent an unrolling of the paper of 20 centimetres, and if the 300 revolutions are caused by a train in going 1 kilometre, it is evident that each centimetre of paper will present a space passed over equal to 50 metres. The breadth of the paper is 6 centimetres ; if the crayon passes over it in twenty minutes, each minute will be measured by a distance of 3 millimetres. It will be readily perceived that curves traced in this way would give all the variations in the speed of the train.

THE "NOVA MOTIVE.

A NEW mode of propulsion is being demonstrated at the Polytechnic Institution, consisting of a series of carriages, carrying along with

them a flexible tube, air-tight. This tube has a series of slide-valves, entirely under the care of a guard, who, by levers, has perfect control over his train. Along the whole line of railway is laid a pipe, in connection with which a series of pistons are fixed between the rails, intended to receive the tube above mentioned in its passage. In these pistons are atmospheric valves, opening into the fixed pipe, which is always kept exhausted, so that when the train passes over the pistons, the slide-valves in the tube are opened by means of inclined planes communicating with the levers, which levers are raised up on the train passing,—the atmosphere existing in the tube to supply the vacuum, and the train is impelled by external atmospheric pressure. — *London Mining Journal*, Sept. 7.

APPLICATION OF IRON TO RAILWAY STRUCTURES.

THE *Civil Engineer and Architect's Journal* for February contains an important report from the commissioners appointed to inquire into the application of iron to railway structures. They say, "As it soon appeared, in the course of our inquiry, that the effects of heavy bodies, moving with great velocity, upon structures, had never been made the subject of direct scientific investigation, our attention was early directed to the devising of some experiments for the purpose of elucidating this matter. The questions to be examined may be arranged under two heads, viz. :—

"1. Whether the substance of metal which has been exposed for a long period to percussions and vibrations undergoes any change in the arrangement of its particles, by which it becomes weakened? 2. What are the mechanical effects of percussions, and of the passage of heavy bodies, in deflecting and fracturing the bars and beams upon which they are made to act?

"A great difference of opinion exists among practical men with respect to the first of these questions. Many curious facts have been elicited by us in evidence, which show that pieces of wrought-iron which have been exposed to vibrations, such as the axles of railway carriages, the chains of cranes, &c., employed in raising heavy weights, frequently break after long use, and exhibit a peculiar crystalline fracture and loss of tenacity, which is considered by some engineers to be the result of a gradual change produced in the internal structure of the metal by the vibrations. Others contend that this peculiar structure is the result of an original fault in the process of manufacture, and deny this effect of vibration altogether, whilst some allege that the crystalline structure can be imparted to fibrous iron in various ways, as by repeatedly heating a bar red-hot, and plunging it into cold water, or by continually hammering it, when cold, for half an hour or more. Mr. Brunel, however, thinks the various appearances of the fracture depend much upon the mode in which the iron is broken. The same piece of iron may be made to exhibit a fibrous fracture when broken by a slow, heavy blow, and a crystalline fracture when broken by a sharp, short blow. Temperature alone has also a decided effect upon the fracture; iron broken in a cold state shows a

more crystalline fracture than the same iron warmed a little. The same effects are by some supposed to be extended to cast-iron.

“ We have endeavoured to examine this question experimentally in various ways. A bar of cast-iron, 3 inches square, was placed on supports about 14 feet asunder. A heavy ball was suspended by a wire 18 feet long, from the roof, so as to touch the centre of the side of the bar. By drawing this ball out of the vertical position at right angles to the length of the bar in the manner of a pendulum, to any required distance, and suddenly releasing it, it could be made to strike a horizontal blow upon the bar, the magnitude of which could be adjusted at pleasure, either by varying the size of the ball or the distance from which it was released. Various bars (some of smaller size than the above) were subjected by means of this apparatus to successions of blows, numbering in most cases as many as 4,000, the magnitude of the blow in each set of experiments being made greater or smaller as occasion required. The general result obtained was, that when the blow was powerful enough to bend the bars through one half of their ultimate deflection (that is to say, the deflection which corresponds to their fracture by dead pressure), no bar was able to stand 4,000 of such blows in succession; but all the bars, when sound, resisted the effects of 4,000 blows, each bending them through one third of their ultimate deflection.

“ Other cast-iron bars, of similar dimensions, were subjected to the action of a revolving cam, driven by a steam-engine. By this they were quietly depressed in the centre, and allowed to restore themselves, the process being continued to the extent even, in some cases, of 100,000 successive periodic depressions for each bar, at a rate of about four per minute. Another contrivance was tried, by which the whole bar was also, during the depression, thrown into a violent tremor. The results of these experiments were, that when the depression was equal to one third of the ultimate deflection, the bars were not weakened. This was ascertained by breaking them in the usual manner with stationary loads in the centre. When, however, the depressions produced by the machine were made equal to one half of the ultimate deflection, the bars were actually broken by less than 900 depressions. This result corresponds with and confirms the former. By other machinery, a weight equal to one half of the breaking weight was slowly and continually dragged backwards and forwards from one end to the other of a bar of similar dimensions to the above. A sound bar was not apparently weakened by 96,000 transits of the weight.

“ It may on the whole, therefore, be said, that, as far as the effects of reiterated flexure are concerned, cast-iron beams should be so proportioned as scarcely to suffer a deflection of one third of their ultimate deflection. And, as it will presently appear that the deflection produced by a given load, if laid on the beam at rest, is liable to be considerably increased by the effect of percussion, as well as by motion imparted to the load, it follows, that to allow the greatest load to be one sixth of the breaking weight is hardly a sufficient limit for safety, even upon the supposition that the beam is perfectly sound.

"In wrought-iron bars no very perceptible effect was produced by 10,000 successive deflections by means of a revolving cam, each deflection being due to half the weight which, when applied statically, produced a large permanent flexure.

"Under the second head, namely, the inquiry into the mechanical effects of percussions and moving weights, a great number of experiments have been made to illustrate the impact of heavy bodies on beams. From these it appears that bars of cast-iron of the same length and weight, struck horizontally by the same ball (by means of the apparatus above described for long continued impact), offer the same resistance to impact, whatever be the form of their transverse section, provided the sectional area be the same. Thus, a bar six by one and a half inches in section, placed on supports about fourteen feet asunder, required the same magnitude of blow to break it in the middle, whether it was struck on the broad side or the narrow one, and similar blows were required to break a bar of the same length, the section of which was a square of three inches, and therefore of the same sectional area and weight as the first. Another course of experiments tried with the same apparatus showed, amongst other results, that the deflections of wrought-iron bars produced by the striking ball were nearly as the velocity of impact. The deflections in cast-iron are greater than in proportion to the velocity.

"A set of experiments was undertaken to obtain the effects of additional loads spread uniformly over a beam, increasing its power of bearing impacts from the same ball falling perpendicularly upon it. It was found that beams of cast-iron, loaded to a certain degree with weights spread over their whole length, and so attached to them as not to prevent the flexure of the bar, resisted greater impacts from the same body falling on them than when the beams were unloaded, in the ratio of two to one. The bars in this case were struck in the middle by the same ball falling vertically, through different heights, and the deflections were nearly as the velocity of impact.

"We have also carried on a series of experiments to compare the mechanical effect produced by weights passing with more or less velocity over bridges, with their effect when placed at rest upon them. For this purpose, amongst other methods, an apparatus was constructed, by means of which a car, loaded at pleasure with various weights, was allowed to run down an inclined plane. The iron bars which were the subject of the experiment were fixed horizontally at the bottom of the plane, in such a manner that the loaded car would pass over them with the velocity acquired in its descent. Thus the effects of giving different velocities to the loaded car, in depressing or fracturing the bars, could be observed and compared with the effects of the same loads placed at rest upon the bar. A great number of experiments were tried with this apparatus for the purpose of comparing the effects of different loads and velocities upon bars of various dimensions, and the general result obtained was, that the deflection produced by a load passing along the bar was greater than that which was produced by placing the same load at rest upon the middle of the bar, and that this deflection was increased when the velocity was in-

creased. Thus, for example, when the carriage, loaded to 1,120 pounds, was placed at rest upon a pair of cast-iron bars, nine feet long, four inches broad, and one and a half inches deep, it produced a deflection of six tenths of an inch; but when the carriage was caused to pass over the bars at the rate of ten miles an hour, the deflection was increased to eight tenths, and went on increasing as the velocity was increased, so that at thirty miles per hour the deflection became one and a half inches; that is, more than double the statical deflection. Since the velocity so greatly increases the effect of a given load in deflecting the bars, it follows that a much less load will break the bar when it passes over it than when it is placed at rest upon it, and, accordingly, in the example above selected, a weight of 4,150 pounds is required to break the bars, if applied at rest upon their centres; but a weight of 1,778 pounds is sufficient to produce fracture, if passed over them at the rate of thirty miles an hour.

"It also appeared that, when motion was given to the load, the points of greatest deflection, and, still more, of the greatest strains, did not remain in the centre of the bars, but were removed nearer to the remote extremity of the bar. The bars, when broken by a travelling load, were always fractured at points beyond their centres, and often broken into four or five pieces, thus indicating the great and unusual strains they had been subjected to.

"We have endeavoured to discover the laws which connect these results with each other and with practice, and for this purpose a smaller and more delicate apparatus was constructed to examine the phenomena in their simplest form, namely, in the case of a single weight traversing a light elastic bar. For the weight in its passage along the bar deflects it, and thus the path of trajectory of the centre of the weight, instead of being a horizontal straight line, as it would be if the bar were perfectly rigid, becomes a curve, the form of which depends upon the relation between the length, elasticity, and inertia of the bar, the magnitude of the weight, and the velocity imparted to it. If the form of this curve could be perfectly determined in all cases, the effects of travelling loads upon bars would be known; but, unfortunately, the problem in question is so intricate that its complete mathematical solution appears to be beyond the present powers of analysis, except in the simplest and most elementary case, namely, in which the load is so arranged as to press upon the bar with one point of contact only, or, in other words, the load is considered as a heavy moving point. In practice, on the contrary, a single four-wheeled carriage touches each rail or girder in two points, and a six-wheeled engine, with its tender, has five or six points in contact on each side. This greatly complicates the problem.

"The above smaller apparatus is so arranged as to comply with the simple condition that the load shall press upon one point only of the bar, and is also furnished with a contrivance by which the effects of various proportions of the mass of the bar to that of the load can be examined. From the nature of the problem, it is convenient to consider, in the first place, the forms of the trajectories that are described, and the corresponding deflections of the bar, when the mass of the bar is

exceedingly small compared with that of the load. Having obtained these under different relations of the length of the bridge, its statical deflection and the velocity of the passing load, we proceeded to investigate, in addition, the effect which a greater proportional mass of the bar or bridge has upon the deflections. Unfortunately, the extreme difficulty of the problem has rendered its solution unattainable, excepting in the case in which the mass of the bridge is supposed to be exceedingly small compared with that of the load, and in the opposite case, in which the mass of the load is supposed to be small compared with that of the bridge. The examples that occur in practice lie between these two extremes; for in the experiments of the commission, performed at Portsmouth, with the inclined plane already described, the weight of the load was from three to ten times that of the bar; but this is a much greater proportion than that which occurs in bridges, partly on account of the necessity for employing in experiments very flexible bars, to render the changes of deflection sufficiently apparent, and partly on account of the great difference in length; for if bars bearing the same ratio of weight to that of the load were employed in experiment, the deflection would become so small as to be scarcely appreciable. This will readily be perceived when it is stated that, in a bridge thirty-three feet long, a deflection not greater than one fourth of an inch is usually allowed, which deflection is only one 1584th part of its length; whereas, in experiment, it is necessary to employ deflections of two or more inches. In actual bridges of about forty feet span, the weight of the engine and tender is very nearly the same as the weight of that half of the bridge over which it passes; and in large bridges the weight of the load is much less than that of the bridge."

The commissioners then state a mathematical investigation made at their request, and continue:—"It is thus shown that the enormous increase of deflection produced by velocity in the Portsmouth experiments cannot occur with real bridges, since it appears that the phenomena in question are developed to a great extent when the magnitude of the structure is diminished. The total increase of the statical deflection, when the inertia of the bridge is taken into account, will be found much greater for short bridges than for long bridges. Supposing, for example, the mass of the travelling load and of the bridge to be nearly equal, the increase of the statical deflection at the highest velocities, for bridges of twenty feet in length, and of the ordinary degree of stiffness, may be more than one half; whereas, for bridges of fifty feet in length, the increase will not be greater than one seventh, and will rapidly diminish as greater lengths are taken. But as it has been shown that the increase, *ceteris paribus*, is diminished by increasing the stiffness of the bridge, we always have it in our power to reduce its amount within safe limits. Hence, in estimating the strength of a railway bridge, this increase of the statical deflection must be taken into account, by calculating it from the greatest load which is likely to pass over the bridge, and from the highest possible velocity. It must be remembered, also, that this deflection is liable to be increased by jerks produced by the passage of the train over the joints of the rails.

“We also made some experiments, by means of the large apparatus before mentioned, on curved bars, and these bore much greater weights at high velocities than straight bars; but the deflections of these bars were very great compared with their length. In drawing attention to these experiments, we would remark that, in actual structures, where the deflections are so very small, the effect of cambering the girders, or of forming a curved pathway for the load, would be of less comparative importance, and might tend to introduce practical inconvenience.”

The general opinion of engineers being at variance with the above results, the commissioners made experiments upon two bridges in actual use and arrived at similar conclusions. They continue:—“In addition to the above experiments, we have made many for the purpose of supplying data for completing the mechanical theory of elastic beams. If they be in any manner bent, the concave side will be compressed, and the convex side extended. From experiments the following formulæ were deduced for expressing the relation between the extension and compression of a bar of cast-iron, ten feet long and one inch square, and the weights producing them respectively:—

$$\text{Extension,} \quad . \quad . \quad . \quad w = 116117e - 201905e^2$$

$$\text{Compression,} \quad . \quad . \quad . \quad w = 107763d - 36318d^2$$

And the formulæ deduced from these for a bar one inch square, and of any length, are:—

$$\text{For extension,} \quad w = 13934040 \frac{e}{l} - 2907432000 \frac{e^2}{l^2}$$

$$\text{For compression,} \quad w = 12931560 \frac{d}{l} - 522979200 \frac{d^2}{l^2}$$

Where l is the length of the bar in inches.

These formulæ were obtained from the mean results of four kinds of cast-iron.

The mean tensile strength of cast-iron, derived from these experiments, is 15,711 pounds per square inch, and the ultimate extension one 600th of the length, and this weight would compress a bar of iron of the same section one 775th of its length. It must be observed, that the usual law is very nearly true for wrought-iron.

“Many denominations of cast-iron have got into common use, of which the properties had not yet been ascertained with due precision. Seventeen kinds of them have been selected, and their tensile and crushing forces determined. Experiments have also been made upon the transverse strength and resistance of bars of wrought and cast iron acted upon by horizontal as well as vertical forces. These experiments will be found to exhibit very fully the deflections and sets of cast-iron, and the defect of its elasticity. The bars which were experimented upon by transverse pressure were of sections varying from one inch square to three inches square, and of various other sections, and the actual breaking weights show that the strength of a bar one inch square should not be taken as the unit for calculating the strength of a larger casting of similar metal, although the practice of doing so has been a prevalent one, for it appears that the crystals in the portion of the bar which cools first are small and close, whilst the

central portion of bars two inches square and three inches square is composed of comparatively large crystals, and bars of three inches square in section, planed down on all sides alike to three fourths of an inch square, are found to be very weak to resist both transverse and crushing pressure. Hence it appears desirable, in seeking for a unit for the strength of iron of which a large casting is to be made, that the bar used should equal in thickness the thickest part of the proposed casting."

The commissioners then go into a detailed notice of the relative merits of the different kinds of iron bridges in use on railways. The simplest bridge, and that which admits of the greatest amount of headway at a given elevation, is, undoubtedly, the straight girder-bridge. The length of a simple cast-iron girder appears to be limited only by the power of making sound castings and the difficulty of moving large masses. In the employment of wrought-iron combined with cast-iron, in the manner of trussing, the greatest skill and caution are necessary to render such combinations safe. The general opinion of engineers appears to be, that the cast-iron arch is the best form for an iron bridge, when circumstances permit its use. Lattice bridges are of doubtful merit. For low bridges the bow-string girder is recommended. The hollow girder form of the Britannia and other bridges appears to possess many advantages, but has not yet been sufficiently tried to warrant the expression of a decided opinion.

In conclusion, the commissioners sum up the results to which they have arrived as follows:—"That it appears advisable for engineers, in contracting for castings, to stipulate for iron to bear a certain weight, instead of endeavouring to procure a specified mixture. That, to calculate the strength of a particular iron for large castings, the bars used as a unit should be equal in thickness to the thickest part of the proposed casting. That, as it has been shown that, to resist the effects of reiterated flexure, iron should scarcely be allowed to suffer a deflection equal to one third of its ultimate deflection, and since the deflection produced by a given load is increased by the effects of percussion, it is advisable that the greatest load in railway bridges should in no case exceed one sixth of the weight which would break the beam when laid on at rest in the centre. That, as it has appeared that the effect of velocity communicated to a load is to increase the deflection that it would produce if set at rest upon the bridge; also, that the dynamical increase in bridges of less than forty feet in length is of sufficient importance to demand attention, and may, even for lengths of twenty feet, become more than one half of the statical deflection at high velocities, but can be diminished by increasing the stiffness of the bridge; it is advisable that, for short bridges especially, the increased deflection should be calculated from the greatest load and highest velocity to which the bridge may be liable; and that a weight which would statically produce the same deflection should, in estimating the strength of the structure, be considered as the greatest load to which the bridge is subject. Lastly, the power of a beam to resist impact varies with the mass of the beam, the striking body being the same, and by increasing the inertia of the beam without

adding to its strength, the power to resist impact is, within certain limits, also increased. Hence, it follows that weight is an important consideration in structures exposed to concussions."

CAST-IRON SLEEPERS FOR RAILWAYS.

A SERIES of experiments has been carried out by Mr. P. W. Barlow, from which he has been led to recommend the substitution of cast-iron in place of wood in laying the substructure of permanent ways, as the only means of preventing those irregularities of surface which cause blows to be given by the engine, that are not only annoying to the passengers, but further are more and more rapidly destructive to the way and to the carriages, as well as wasteful of the locomotive power and mechanism. Mr. Barlow finds it to be a mistake, that a partially soft elastic material, such as wood, is requisite to smooth and easy motion; the more rigid, and level, and polished the surface, the easier has he found the traction, and the better suited at least to railway transit. Cast-iron sleepers in halves, with half-chairs fitting the rail, and bolted together, so as to avoid the use of the key, is that construction of substructure to which experiment has led him to yield the preference, from the facility with which it is laid, from the perfect joint which it gives, and the security from breakage in the event of getting off the line. The point of the meeting of the plates is situated between the chairs, so that the bolts act under a spring which destroys all liability of loosening, to which he has not found any tendency. —*London Builder, Feb.*

PREVENTION OF DUST AND SMOKE ON RAILROADS.

MR. N. GOODYEAR of New York has invented an apparatus for preventing passengers on railroads from being annoyed by dust and smoke. On the roof of the car a number of ventilators are arranged, so as to allow the air to pass freely into the car when it is in motion. The mouths of these ventilators are covered with a fine wire cloth, through which the air circulates freely, but which effectually stops all cinders and other dirt. In each window of the car is placed a sash of blinds, constructed of plates of glass four inches wide. These blinds are so arranged that they are all moved by a connecting-rod, in the same manner as ordinary window-slats are opened or shut. The air, coming through the ventilators, passes with a gentle current out of the blinds, or "car-dusters," as they are called, the outward current thus formed effectually preventing the entrance of a particle of dust into the car, and the outside current, formed by the motion of the car, carrying the dust to the rear. Besides entirely excluding the dust and smoke, it is claimed that this invention, which does not at all obstruct the view, will ventilate the cars, and, by stifling the noise, render conversation much easier than at present. An apparatus of this sort has been applied to a car on the Hudson River Railroad. —*New York Tribune.*

RAILWAYS IN ENGLAND.

THERE are now in England about 5,000 miles of railway worked by nearly 2,000 locomotives, which in the course of a single year collectively travel over more than 32,000,000 of miles, — amounting in three years to the distance from the earth to the sun, or as much as three and a half times round the world per day; and carrying in the course of a single year not less than 60,000,000 passengers and 20,000,000 tons of goods. The rails upon these lines — which exceed 24,000 miles in length, and would therefore gird the earth around with an iron band, weighing about 70lbs. per yard — have been raised from the mine, smelted, forged, and laid in the course of the last fifteen years; whilst in the construction of the ways 250,000,000 cubic yards, or not less than 350,000,000 tons, of earth and rock have, in tunnel, embankment, and cutting, been moved to greater or less distances.

NOISELESS CARRIAGE-WHEELS AND HORSE-SHOES.

In the *Mining Journal* of July 22, 1848, we noticed the introduction of some improvements in the construction of wheels for carriages, by Mr. Andrew Smith, which were likely to prove of much value to the public, as not only adding greatly to comfort in travelling over paved streets, from their being perfectly noiseless, but from their combining a much greater degree of safety. The principle consists in forming the hoop or tire of two separate layers of galvanized iron, which are riveted together, and regalvanized in the mass; this division of parts cutting off all vibrations when travelling over the roughest stones. Mr. Smith has also applied the principle to springs, in which each plate is galvanized separately, and can never rust. The axle is also made to fit the axle-box with perfect exactness, by a lining of fusible metal, and is itself lubricating, and not liable to heat; the whole secures a degree of quiet, ease, and safety hitherto unattained. We have been led again to notice these ingenious improvements, from the fact that the patentee, having produced a noiseless carriage, found that the horses' feet made more noise than ever, and, seeking for a remedy, has applied the same principle to the horse-shoe. This is effected in the most simple manner, by making the shoes in two thicknesses of galvanized metal, then riveting them together, and re-galvanizing. A horse equipped in these pumps trots over the granite streets of London as softly as if he was on a bowling green. — *London Mining Journal*.

IMPROVEMENT IN RAISING AND LOWERING CARRIAGE-TOPS.

DR. J. L. ALLEN, of New Haven, Conn., has invented an improvement, by the use of which a carriage-top can be raised, lowered, or held at any desired elevation, as easily from the inside as the outside of the carriage, and without the necessity of moving from the seat. One brace only is used, of very nearly the same form as usual; the centre limb is hung upon a prop, which is hollow, and the bolt which

is fastened to the brace passes through the prop to the inside of the carriage-top, where it connects with a hand-hold lever. By simply moving this lever backwards or forwards, the top is let down or raised up. Another handle, attached to a rod at the lower end of the brace, may be used in the same manner instead of the hand-hold lever. To use this single brace with double joints, the slats or bows forming the frame-work of the top must be hung on the same centre. The braces on the two sides of the carriage-top are connected together by a rod, which lies against the back of the seat under the lining. By means of this connecting-rod, the braces on both sides are operated simultaneously by moving the lever. A spiral spring is wound around the connecting-rod, one end being fastened to the back of the seat, and the other to the rod itself. The spring is proportioned to the weight of the carriage-top, two being sometimes used. As the top falls, the spring winds around, so that it drops slowly and steadily, while a very slight pull of the lever is sufficient to raise it. By means of a looped cord passed over a nob, the carriage-top may be held at any angle of elevation. — *Scientific American*, Dec. 7.

NEW STIRRUP-IRON.

AMONG the gold medals awarded by the American Institute in New York the present year, was one to Mr. Nathan Post, of East Cleveland, Ohio, for a new stirrup. Its excellence consists in a spring-guard, which allows the foot to go into the opening only a certain distance. This guard, by means of a centre tube and screw, may be elevated and lowered to allow the foot to go in a greater or less distance. There are various other contrivances, and its whole effect is, that, if the rider is thrown from his horse, it is impossible for his foot to stick in the stirrup, for the guard throws it out at once. — *Scientific American*, Nov. 16.

HYDRO-PNEUMATIC LIFT.

THE *Glasgow Practical Mechanics' Journal* for March contains a description of "Simpson's Hydro-Pneumatic Lift for Furnaces and Railway Elevators." The principle is that known as *flotation*. An air-tight sheet metal case, of sufficient displacement for the greatest weight it is designed to raise, is immersed in a well containing water, and attached, by means of a large vertical pipe of the same material; to an upper platform rising between guides. When the case is released it will of course ascend, carrying upon its platform the articles to be raised. The valve-apparatus for governing the motions, &c., constitutes the novelty of the machine. The "float-case" is made spheroidal, and is connected, as has been described, to the platform by a hollow pipe, closed above by the platform, and below perforated, so that in the movement of the machine its bulk shall not materially affect, by a greater or less degree of immersion, the usual level of water in the well. The float-case itself is provided with a small pipe rising in the centre of the large one, which opens to the air above by means

of a governing valve, and also serves to protect a valve-rod, connecting the operator on the platform with a small screw-valve in the bottom of the float-case, designed for the ingress and egress of water. The large hollow pipe is also provided with a small valve above, for governing the outlet of air. An induction-pipe enters at the top of the well, and is always open. A discharge-pipe at the bottom is provided with a valve, opening outward, whose lever is weighted, so as to counterbalance the pressure of water tending to open it. The operation of the machine is as follows:— Suppose the float-case full of air, and at the bottom of the well, which is empty; all the valves are shut. If, then, water be allowed to fill the well, the buoyancy of the float causes it to ascend, carrying upon its platform the goods to be elevated. To descend, open the screw-valve in the float-case, and its governing air-valve, until a sufficient body of water has entered to destroy buoyancy, when, the air-valve to the large pipe being also open, the machine will descend with any desired velocity. On approaching the bottom, the open screw-valve comes in contact with the weighted lever governing the discharge, and has just time to open it, when the float subsides into the bottom of the well, made of exactly the same shape as that of the float, thus opening a passage between the float-case and the discharge-pipe, permitting water to escape until its buoyancy is sufficiently restored for a reascent. As the float-case exactly fits in the bottom of the well (the fit being secured by packing), no water is permitted to escape from the well itself. It will thus be seen that this machine possesses two advantages over the usual plans of flotation. 1. Only the exact amount of water required to balance the load and to overcome friction is expended for each lift. 2. The well being always full, no time is lost in filling and emptying it.— *Journal of Franklin Institute, July.*

IMPROVED HYDRAULIC RAM.

THE *Journal of the Franklin Institute* for November contains the report of a committee appointed to examine an improved hydraulic ram, the invention of Mr. H. P. M. Birkinbine, of Philadelphia. The principal improvements consist in constructing the discharge-valve so that, as it rises into its seat, a portion of water is caught between the valve and seat, and thus a water-cushion is formed, which prevents the heavy blow, and the consequent rapid destruction of the apparatus. The cup or air-chamber, which in all these machines is placed at the discharging orifice, to arrest gradually the impact of the water there, is placed upon the valve itself, and not upon the valve-seat, so that the shock upon the valve is materially lessened. The drop-cup, into which the guide-stem of the valve falls, is adjusted by means of a wedge, controlled by an adjusting screw, so that the amount of fall of the valve may be accurately set and altered when a change of circumstances requires it, so that the quantity of water discharged by the valve can be reduced or increased at pleasure. The driving-pipe, or that which conveys the water from the fountain-head to the ram, is in a cycloidal form. About 1,000 of these rams, which the committee

highly recommend, have been put in use. The largest are worked by driving-pipes 6 inches in diameter. One of this size, with a fall of 6 feet, lifts 20,000 gallons per day 60 feet. The improvements described permit the instruments to be made of much larger size than usual, and they last longer and are less liable to get out of order.

HYDRAULIC PRESSURE IN COAL-MINES.

It is stated that a powerful hydraulic engine is used at the Minton Colliery, for the purpose of drawing the trains of wagons under ground, without the aid of steam-engine or of horses. The engine consists of two small cylinders and pistons, each being 3 inches in diameter, with a 12-inch stroke; the water which supplies the power is that pumped from the shaft, collected in a reservoir 606 feet above the level of the water-engine, and, of course, applying an enormous force on the pistons; the pipes conveying the water down the shaft are $4\frac{1}{2}$ inches in diameter; the distance from the shaft, whence the trains are at present propelled, is 880 yards, with gradients from 1 in 30 to 1 in 18; the number of tubs in each train is 20; the speed is at the rate of 6 miles per hour; the quantity of water pressing on the pistons is 1,500 gallons, and the average speed 100 strokes per minute; the power of the engine is about 30 horses, and the reservoir and column of water collects enough to draw 20 trains a day; but although it is contemplated to increase that number to 50, that extra number will only involve the pumping of an extra 30 gallons per minute through the 24 hours. — *Civil Engineer and Architect's Journal*, May.

CYLINDRICAL ROTARY PRINTING-PRESS.

THE *New York Tribune* describes a new printing-press, the invention of Mr. J. A. Wilkinson, of Providence, R. I. It says, "All the motions of this press are rotary. The types are adapted to and brought into a perfectly circular form, and placed on cylinders, one of which is made to print the upper, and the other the under side of a continuous sheet of paper, which is made to pass directly through the machine and come out printed on both sides, folded into a convenient form, and cut off ready for delivery. All the reciprocating movements heretofore used are abandoned, and simple rotary motions substituted throughout. Consequently, the exceedingly smooth and uniform action of this press is almost exempt from the danger of getting out of order, and subject to very little wear. The types, moreover, possess, in their shape, a great advantage. They are so formed that they must necessarily all stand the right way, and in their action upon the paper are not subject to injury by being battered; and they are much less worn and disfigured by use than type employed in the old way. To which may also be added the important advantage of casting upon the radii of a circle, and using upon the cylinder stereotype plates exactly conformable to the cylinder, and made to move, like the type, completely in a circle. The velocity in the movement of this press is

perhaps the most extraordinary feature. Such is the astonishing rapidity with which impressions may be multiplied, that at an ordinary speed 20,000 imperial sheets may, with great ease, be printed on both sides, folded, and cut neatly from a continuous sheet, in one hour's time. Thus 40,000 impressions can be made, besides the folding and cutting of the sheet, in one hour, by a single machine, without the aid of the human hand. It can be worked by any ordinary power, one man or active boy only being required to attend a press, place the roll of paper upon the machine, and carry away the printed and folded sheets as fast as they are thrown from the machine.

NEW PRINTING-MACHINE.

SEVERAL gentlemen connected with the press in Paris, and the head of a large printing establishment in Scotland, assembled, on Saturday, at the manufactory of M. de Coster, to witness the performance of a new printing-machine, invented by M. Worms. It occupies a much smaller space than the machines now in use in the great printing establishments of Paris and London, costs less than half the price at which one of those can be had, and is free from the tapes and other guiders, which frequently get out of order, and occasion considerable delay. It requires only the labor of three men to feed it, and receive the work as it is thrown off. This new machine, which is called *rotative*, does not print from the types, but from stereotype, and this is the most extraordinary part of the process. In the ordinary process of stereotyping several hours are required; for the material used for receiving the impression of the type, and which serves as the mould in which the stereotype is cast, must be carefully and slowly dried. The mould for the stereotype, by this new process, is made of a few sheets of tissue-paper, with a couple of sheets of common paper at the back, to give a certain degree of strength. The paper is wetted to the proper degree, and then pressed upon the type. The impression is perfect. The mould is then dried, which is the work of only a few minutes, and placed on a cylinder, with a sufficient space between it and an outer case to receive the metal. This metal, which is very liquid, and which is prepared in a peculiar way, flows rapidly and evenly over every part of the mould, and, by the application of a cold, wet sponge to the exterior, it becomes almost instantly solid. The plate is then removed and transferred to the cylinder of the machine, ready for printing. One part of the plate fits in exactly to a groove made to receive it, and the other part is held by screws. The whole of the stereotyping does not occupy more than from fifteen to twenty-five minutes.

The action of the machine differs entirely from any thing hitherto invented. There is no laying on of the sheets to be printed. A continuous sheet of paper, equal to 2,000 or more sheets of a newspaper, is rolled on a cylinder, and, as the machine turns, the plate on the printing cylinder is fed, and, by the action of the machine itself, the paper is divided at the proper place into sheets of the desired size, and each sheet is folded at the same time. The paper which receives the

impression is not wetted, as in other printing processes; it is placed on the cylinder as it comes from the paper-maker, but so certain and regular is the pressure, that the impression on this dry paper is equal, if not superior, to that obtained upon damped paper in the ordinary way. There is an index affixed to the machine, to indicate the rate at which it goes, by the number of sheets thrown off. When the continuous sheet, equal to 2,000 copies of a journal, is exhausted, the cylinder is replaced by another, and so on. It is said that as many as 15,000 copies of a journal can be printed in an hour by this machine. The cost of one of these machines is \$5,000. A font of type, being subjected to but little wear, will last many years.—*Galignani's (Paris) Messenger*.

PRINTING-MACHINE FOR THE BLIND.

MR. HUGHES, the governor of Henshaw's Asylum for the Blind, has invented an ingenious printing-machine. It consists principally of a circular disk of brass, close to the edge of which is an embossed alphabet, with the usual figures and points used in punctuation. Inside of this circle is a disk of common letter-press types, corresponding in number with the raised letters of the outer circle. The disk is moved longitudinally by means of a screw, and any letter that may be wanted is brought under a lever placed at right angles with the screw, which keeps the writing in a straight line. The types act upon carbonized paper, under which is placed a sheet of white paper on a piece of pasteboard, and thus the desired impression is conveyed. The machine is only a foot square.—*London Mining Journal*, March 2.

MACHINE FOR FOLDING NEWSPAPERS AND BOOKS.

It was announced some time since that a machine for folding newspapers and other printed matter had been invented in Springfield, Mass. A variety of circumstances have delayed its being brought into use till recently. During the past year, however, one of these machines has been successfully used in the offices of the *Boston Transcript* and *Springfield Republican*. The principle of the invention will be understood from the following description of one of the folders, as applied to one of Taylor's cylinder power-presses in the *Transcript* office. The folder is adjusted to the press, and is driven by the same power, and at the same speed. As the sheet emerges from the printing cylinder, it is received upon a moving apron, composed of endless bands revolving on rollers placed at either end. On reaching the extremity of this apron, which is nearly double the length of the sheet, the paper is struck in the middle from beneath by a folding knife, or straight edge, upwards, between two revolving cylinders, placed at right angles with the apron, to make the first fold. From these cylinders, the doubled sheet issues upon a second apron, moving at right angles with the first, and upon a higher plane, upon which it is carried under a second pair of folding rollers, and the second fold, at right angles with the first, is completed in the same manner; a third fold is

given parallel with the second, and a fourth at right angles with the third, when the sheet, having received the folds required, emerges between a pair of pressing rollers upon the stand or carrier's basket. The folding knives or straight-edges are raised and withdrawn by means of cams. The whole process is exceedingly rapid, the machine, when driven by steam-power, folding the papers as rapidly as they can be printed, and with greater neatness and accuracy than can be done by hand. The rollers are supported in a stout wooden framework, and the whole machine occupies about the same space as the printing-press. It is managed by the ordinary pressman, requiring no additional attendant. It has been in daily and successful operation for nearly a year, and has given great satisfaction. The patent-right for this country and Europe is owned by a company, of which Hon. Geo. Bliss is President, incorporated by the Massachusetts Legislature. Several more of the machines are finished and about to be brought into use. The folder can be applied to folding books and pamphlets as well as newspapers, with a slight alteration of the machinery, and it is here that its importance is most obvious. — *Editors.*

CLEMENS'S COTTON-PRESS.

MR. S. A. CLEMENS, of Granby, Conn., has invented a cotton-press which is alike remarkable for the principle and efficiency of its action. The various kinds of baling-presses hitherto in use are designed to compress at once the whole amount of material forming the bale, and hence require an application of power sufficient to meet the expansive tendency of the entire mass. Differing from all these, this new press forms the bale by a continuous process of aggregation, only a small quantity of the material undergoing condensation at any moment, while the expansion of the accumulating mass is prevented, in such a way that it does not react upon the motive power which drives the machine. As a baling-press, it admits of universal application, such modifications being made in the subordinate parts as may be necessary in adapting it to the nature of the material upon which it is designed to operate. When used for baling cotton, it is attached to the common plantation cotton-gin, and driven by a belt connecting the two machines. A description of the process by which a bale is formed will serve to introduce the characteristic features of the invention.

The cleaned cotton, as it is thrown from the gin, falls upon a lap-cylinder, where it is formed into a continuous sheet of uniform width and thickness. This, descending from the lap-cylinder, passes between two horizontal cylinders, which are in the middle of a system of horizontal rollers, devised to lie upon the cotton when condensed in the machine, and prevent its expansion upwards. Passing between the receiving cylinders, the "lap" of cotton rests upon a table suspended below the horizontal rollers by four vertical screws, supported above by a carriage, which, resting upon girders of the frame which receive the bearings of the rollers, is made to traverse back and forth a distance corresponding to either the width or length of the bale, according as the machine may be arranged. The screws are geared together

at their heads by light bevelled wheels and connecting shafts, and by means of a hand crank conveniently attached to one of these, the screws are turned simultaneously, and the table is run up to the lower side of the rollers, preparatory to the formation of a bale. The horizontal rollers and receiving cylinders are all geared to roll back and forth upon the cotton, their motion being made exactly to correspond with the reciprocating traverse movement of the carriage and the attached table beneath. On one of the shafts connecting the screws, a ratchet-wheel is fastened, which, at the termination of each traverse movement, alternately engages two catches, suitably attached to the frame which turns the screws, and the table descends.

Thus arranged, the table on which the bale is formed by its traverse movement in connection with the corresponding rotation of the rollers and receiving cylinders, draws in and condenses the sheet of cotton, as it is delivered from the lap-cylinder. As the motion of the carriage and the table and its incumbent cotton is reversed, the sheet is folded back by the cylinder under which it is drawn, while, simultaneously with the change of movement, one of the catches engages the teeth of the ratchet-wheel, and, releasing the screws, causes the table to descend sufficiently for the admission of another layer of condensed cotton.

The bale is thus gradually formed by a succession of layers, and is everywhere uniformly condensed and perfectly regular at the sides and ends, there being no tendency to expansion, save towards the table below and the rollers above by which it is effectually confined. The rope and bagging for securing the bale are easily applied, the covering for the bottom of the bale being spread upon the table before it is run up to the rollers, and the bagging for the top of the bale, together with the ropes, may be passed between the receiving cylinders and laid upon the upper side of the bale by a single transverse movement of the carriage and its attachments. When the machine is arranged to traverse the bale endwise, the ropes are applied by passing them over the bale between the rollers, which for this purpose are set apart at suitable intervals. Hoop-iron can be substituted for ropes in putting up the bale with much greater facility than is practised in connection with the common baling-presses, and, by using a clasp-lock contrived by the inventor of the machine, the inconvenience of riveting is avoided, and the operation of securing the ends of the hoop is accomplished with expedition. The quantity of cotton in process of condensation at any instant being that portion passing between and under the cylinders, the demand for motive-power requisite to operate the machine has reference chiefly to the friction of the working parts. This element of resistance is favorably met by the slow motion of the machine, the formation of two or three layers per minute being sufficient to keep pace with the performance of a first-class cotton-gin; and, by causing the carriage to run on truck-rolls, the friction arising from the expansive pressure of the cotton is confined to the bearings of the receiving cylinders and rollers.

The principle of action being patented, a wide range is secured in the choice of combinations and styles of construction for the attainment

of cheapness and efficiency of action. The parts may be chiefly made of wood, and the cost is insignificant compared with the working capacity of the machine. Instead of the rollers on either side of the receiving cylinders, two horizontal tablets may be substituted. In connection with this mode of confining the cotton, attachments supported from the carriage are necessary to impart a traverse motion to the bale. A machine of this description was exhibited at the late Fair of the Massachusetts Mechanics' Association in Boston, and elicited the award of a gold medal to the inventor. In this machine, cotton was compressed to the density of more than forty pounds per cubic foot, and while effecting this enormous condensation, nearly threefold what is attained by the common plantation press, the power of one man applied to the driving-pulley was found sufficient to overcome the resistance. Several of these machines have been ordered by parties from Georgia, and are shortly to be forwarded to their destination. — *Editors.*

GRAIN-DRYER.

MR. CHARLES S. SNEAD, of Louisville, Ky., has invented a very excellent grain-dryer. It is composed of a number of hollow semi-spherical tubes, the upper part of which are concave, so as to receive the grain. These pipes, being hollow, are heated by steam, and any number of them are set at a small distance apart, above one another, firmly secured to a frame. There is an opening made through every one, to allow the grain to drop from one to the other, thus passing through and over the whole set of tubes. There are a number of rakes placed at different distances apart on radiating arms, and these rakes are set in motion by a band and pulley driving the vertical shaft, on which the rake-arms are secured. They thus continually stir the grain and carry it forward and around each tube, pushing it into the opening, whence it drops into the next tube, and so on, till it comes out at the bottom perfectly dry. The grain is delivered to the machine by a hopper at the top. — *Scientific American, April 20.*

ANTI-FRICTION PRESS.

THE *Scientific American* for March 30 gives a description of Dick's anti-friction press, adapted for pressing cotton, punching, straightening railroad-iron, embossing, and for every kind of pressing. It is compact, and presents a most important arrangement of mechanical powers, to avoid friction. The great principle of this invention is the saving and centralizing of the power, by directing the power, which is applied through a line of contact points, and reducing very much the loss usually caused by friction. Its general construction is as follows. An upright frame has two partial rotating cams, placed one above the other, and between them an axle passes, having a cog-wheel near each extremity, so as to be outside of the cams, but within the frame, the axle being allowed to move slightly in its bearings. Pinions on fixed axles, one on each side, key into the cog-wheels, and

are operated by cranks. Above and below the cog-wheels, on each side, are sectors, whose general shape is triangular, the apices of the upper ones being turned upwards, and those of the lower downwards. The axle of the lower cam rests upon the curved surfaces of the lower sectors, while that of the upper one presses on the curves of the upper sectors. The axle of the upper cam moves upwards in its side bearings, and the upper sectors are pressed upwards, pushing up a plate, which moves in guide-slots in the erect frame, so as to press any thing placed on it against some rebutting back. The upper sectors move in one direction, while the lower ones move in the contrary direction, bringing their curves to act most effectually, balancing all the motions, and acting in right lines through *points* of contact, produced by the contact of the curved surfaces of the axles, cams, and sectors; consequently the amount of friction is very small. These presses have been very extensively introduced, and are highly spoken of.

STEAM-PLOUGH.

MR. JAMES USHER described to the British Association, at Edinburgh, a steam-plough of his invention. He says that all former attempts at ploughing by steam have gone on the principle that ploughs must be *dragged* through the earth, whereas a moment's consideration will show that the ploughshare and its bearer are exactly similar to a common anchor, which, if thrown into the sea, will hold even the largest vessel. To obviate this difficulty, in the present machine the plough is reversed, and made like an anchor, thrown out before a ship, by which the vessel is hauled forward; or, in other words, the plough is inside a paddle-wheel, instead of an anchor cast astern, and thus the carriage is propelled along the land. To obviate the objection that five or six ploughs entering the earth at the same time would lift a solid piece of earth and carry it round, though all the ploughs are put on the same axis, they are so arranged that no two shares come into action at the same moment. On applying the power of the steam-engine to the ploughs, it was found that they ran along the earth without turning it over, and it became necessary to affix a drag to the wheels, which was done by connecting the wheels of the carriage with the wheel which drives the ploughs, so that a uniform stroke is obtained for each plough, and it cannot proceed till it has turned over the desired area. By this it will be seen that the ploughs drive the carriage-wheels at the necessary reduced speed, the forward motion of the machine being communicated from the plough to the carriage, instead of from the carriage-wheels to the ploughs. The machinery used consists, generally, of a locomotive boiler and engine, placed in a frame above the wheels, the weight being so disposed as to be principally over the hind wheels. The fore wheels are fitted to a revolving frame, similar to an ordinary road carriage, to be turned round in a small compass. The ploughs can be elevated or depressed for deep or shallow ploughing. — *Civil Engineer and Architect's Journal*, Oct.

LORD WILLOUGHBY D'ERESBY has published a pamphlet describing another steam-plough, which consists of a locomotive engine, weigh-

ing $3\frac{1}{2}$ tons, and of 26-horse power. The engine moves across the centre of the field on a light portable railway. The ploughs advance and recede on either side of the railway, at right angles to it. The plough employed consists of four ordinary, and the like number of subsoil ploughs, fixed in a frame; it is directed by a person standing upon a small platform. While the advancing plough on one side is working, the receding one on the other is idle, till it regains its proper position for ploughing the next four furrows. The ploughs are attached to an endless chain, 150 yards long, and provision is made in case they strike against any impediments. Such a machine performs the work of sixteen ploughs, driven by as many men, and drawn by thirty-two horses. — *London Builder*, Sept.

MACHINE FOR HAMMERING WROUGHT-IRON.

In the process of hammering or shingling, welding, and rolling wrought-iron, letters patent have been granted for a machine, the invention of a well-known iron master, which promises at no distant day to make a revolution in the forge and the rolling-mill, and much decrease the price and improve the quality, not only of the heaviest wrought-iron shafting, but even of the smallest rods. This machine consists of three or more conical frusta of metal, confined in a frame, with their smaller ends downwards, in such a manner that revolution may be imparted to all of them, and the axis of each of them is arranged as near as a right line can be upon the periphery of an imaginary inverted cone, in such a direction that a line drawn through each axis would not point exactly to the apex of the imaginary cone above alluded to, but a little on one side of it. By this arrangement, a space like a hopper is left between the frusta, and gradually diminishes as it descends. Masses of iron at a welding heat, or thereabouts, are thrown into this receptacle, and a rotary motion imparted to the frusta, which, on account of their axes being eccentric to the apex of the imaginary cone, gradually screw the heated mass downwards, compress it and force it out through the circular space between the smaller ends of the frusta. The iron is therefore drawn out, and as it is drawn the fibres are twisted so that they are placed in the rod much in such a way as are the yarns in a strand of rope. By giving slight eccentricity to the axis of the frusta, and great velocity of revolution, the strain of them upon their journals may be reduced to any extent required. Puddlers balls may be squeezed in this machine, shafts of any size may be forged, and round iron of any dimension rolled. In the experimental machine a three-inch billet has been rolled down, at one operation, to a half-inch rod. — *Patent-Office Report*, 1849.

MACHINERY FOR ROLLING IRREGULAR FORMS.

MR. JOHN S. HALL, of Columbus, Ohio, has patented some machinery for rolling irregular forms of metal. The nature of it consists in connecting with the rollers of an ordinary rolling-mill, a shaft

above, with cam-rollers thereon, to act upon the roller or rollers below, one or two of which move up and down in their bearings, rising and falling while revolving, to draw metal bars to any pattern, and of any size, according to the pattern of the cam, and the speed of the rollers and cam-shaft, which can be varied by gearing so as to make a small cam roll a long bar, and *vice versâ*.—*Scientific American*, March 23.

EXPERIMENTS WITH GALVANIZED WIRE AND HEMP ROPES.

EXPERIMENTS have been made in Woolwich Dockyard to ascertain the comparative strength of wire and hemp ropes. A wire rope, 3 inches round, and a hemp rope of 3 strands, hawser laid, common make, 7 inches round, were spliced together, and placed in the testing machine, and, on the hydraulic power being applied, the hemp rope broke in the middle on the strain reaching $11\frac{1}{2}$ tons, the wire rope remaining apparently as strong as when the experiment commenced. A wire rope, $3\frac{1}{2}$ inches round, was then spliced with an 8-inch hemp shroud-rope, and, on the power being applied, the hemp rope broke in the middle with a strain of $10\frac{1}{2}$ tons, the wire rope continuing apparently uninjured. — *American Railroad Journal*.

MANUFACTURE OF IRON CASKS OR VESSELS.

MR. S. DA COSTA has recently taken out a patent for "improvements in vessels for holding solids or fluids, and in machinery for manufacturing such vessels." The invention relates particularly to the construction of barrel-shaped vessels of iron, in the manufacture of which the patentee forms the body part by bending the plate or sheet-iron, by means of rollers, somewhat similar to plate-bending rollers used for boiler purposes; the plate used being such as will form either one half of the vessel, or complete the entire circle. The upper bending or shaping roller, for this purpose, is formed of a barrel-shape (that is, larger at the centre than at the ends), more or less, according to the shape to be given to the plate, while the under roller is the reverse of the upper, so as to receive it and squeeze the plate between them. On the ends of the upper roller are two cutting disks, or edges, which pare the edges of the plate, as it is passed between the rollers. A third roller is employed to guide and give the direction to the plate under operation, its position being variable so as to bend the plate more or less as may be desired. The plate, after being heated red-hot, is passed through the rollers, which, at one and the same operation, bend, shape, and trim the body part of the vessel.

The plate, after being bent, encircles the upper roller; and in order to remove it readily, the patentee forms one of the bearings of a spherical shape, which allows the opposite end to be raised, for the purpose of removing the bent plate. The rollers are so formed as to set back a small portion of the plate at each end, so as to form an enlargement for the reception of the ends of the cask; the enlarged end is of a cylindrical form, or rather slightly coned outwards, to render the ends more easily introduced and fitted. The ends are formed of plate-

iron, having an edge turned up, which fits the enlarged part of the end, and is, after being fitted, brazed in its place.

The machinery may be varied by using two lower rollers, instead of one, the three being so geared together as to produce a like motion of their peripheries, or as nearly as possible, taking the medium of their diameter. A third machine for the same purpose consists of two blocks, having semicircular cavities, opposed to each other, and which are drawn together or expanded by means of right and left hand screws on a shaft; the plate, having been partially bent, is introduced between the two blocks, and, by drawing them together, completes nearly the entire circle. The hollows or cavities of these blocks are of the same barrel form, and, in order to press the bent plate into them, the patentee employs a shaft, concentric with the hollow blocks, carrying between two crank-arms and a barrel-shaped roller; after the plate has been partially formed, the shaft is caused to rotate, by which the roller will be rolled round the interior surface of the vessel under formation, causing it to be compressed into the cavity in the blocks. — *Civil Engineer and Architect's Journal*, Jan.

IMPROVEMENTS IN WIRE-ROPE.

THE *London Mining Journal* for June 1 contains a description of some improvements in the manufacture of wire-rope, the invention of Mr. James B. Wilson. The first improvement consists in winding the wire, as it comes from the ordinary draw-plates, on to blocks revolving in opposite directions. By this means, when the wires are made into ropes, the ropes have no tendency to twist, because the wires, being wound in opposite directions, counteract one another. The next feature consists in forming flat wire-ropes, by causing several series of wires, or wire-strands, to be braided together, so as to form, *without stitching*, a flat rope, which may be made of any requisite degree of elasticity, by varying the angle at which the wires are laid. The next improvement consists in the mode of making ropes, which are particularly applicable for standing rigging of ships, as they can be made elastic enough without the aid of India-rubber or spiral springs. This is done by coiling two or more layers of wire in opposite directions, so as to form a compound strand. The spaces between the wires and between the strands may be filled up with gutta-percha, hemp, or other matters, to diminish the wearing of the wires.

SEWING-MACHINE.

MR. W. C. WATSON, of Patterson, N. J., has invented a sewing-machine which produces work of a very superior character. It uses two threads to form the stitch, one by a shuttle and the other by a needle, the motion of the two being regulated to form a lock-stitch, which will not rip out. It makes one stitch during the forward and another during the backward motion of the shuttle. — *Scientific American*, Aug. 10.

LOOMS FOR WEAVING DIFFERENT PATTERNS.

MR. JOSEPH REYNOLDS, of Providence, R. I., has invented an improvement in looms for weaving shawls of different patterns, gingham, carpets, and any kind of pattern goods. The advantage of Mr. Reynolds's improvement over all other plans in use, for changing the shuttle, is, that his plan has full control of a series of shuttle-boxes, applied either to one or both ends of the lay, as may be required, and that pattern-plates are used to be set to any pattern which may be designed in stripes; or, if connected with a jacquard, the improvement may be employed for weaving carpets with any kind of figures made of different colors of the weft. The pattern-plates are set according to the design of the pattern to be woven, and by their combination with levers and bell-cranks to the shuttle-boxes, each shuttle is moved, or kept in its proper place to be moved when required. For example, if five shuttles are used, and the middle one is red weft, while the others on each side may be blue, green, orange, and purple, the shuttles can be changed, as set by the pattern-plates, to take up the red shuttle, or any other one of the five. The shuttles can also be set to vary in their operation from a few inches to yards, such as weaving the border of a shawl with a few picks of one and more of another color, making stripes in the weft; the loom will weave the whole middle of the shawl, without a change of weft, to have it all one color, after which the shuttles come in play to work out the opposite border. One operative can attend two looms. — *Scientific American*, March 23.

AMERICAN SPOOL-COTTON.

AT the annual exhibition of the Franklin Institute, in Philadelphia, a specimen of white and colored six-cord spool cotton, manufactured by the Sagamore Company, of Portsmouth, N. H., was exhibited, of which the committee say, "This is a new and a very important article, and has not, as far as the judges know, been heretofore manufactured in the United States. The specimen exhibited is so superior in strength, color, style, and evenness, that we heartily recommend a gold medal."

IMPROVEMENTS IN FIRE-ARMS.

MAJOR HAGNER, in his report to the Ordnance Bureau, describes a gun which has been used by one French corps for several years and has proved highly successful, and is now about to be introduced for arming the foot rifle corps in Belgium and Holland. It is an attempt to introduce the rifle principle into fire-arms, under a form giving the advantage known to be due to the grooved arm with a forced ball, without the objections formerly belonging to that principle. "The essential difference between this arm and grooved arms previously known is, in having a stem of small diameter attached to the breech-pin in the axis of the bore, upon the end of which the ball rests in loading, and then, with the rammer, it is easily made to fill the

grooves of the barrel, without essentially altering the shape known to be best to secure to it velocity and a rotary movement in the direction of its longest axis. The stem is a cylinder of steel, tempered at the end upon which the ball rests, and screw-threaded at the other end for a length of 1 centimetre; the diameter .009 millimetre, and the height above the breech .038 mil. The barrel has 4 grooves, with the inclination of 2 metres in one revolution; breadth of groove 7 mil.; the depth varying from 3 mil. at the breech to 1.5 mil. at the muzzle of the musket. A special *hausse*, with a hinge-joint, is attached about 4 inches in front of the cone, admitting of three fixed sights, and with a movable slide for higher elevations. Gen. Tournemine told me that the altered musket had been fired at 1,200 metres, placing 66 balls in the butt in the 100; the carbine the same at 800; and the artillery carbine (having only $23\frac{1}{2}$ inches length of barrel) placed 56 per cent. in the butt at 400 metres. Far inferior results would commend strongly the introduction of a principle which secured them. The shape of the ball (every line of which is said to have been established, as it now is, upon special trial) can be best judged of from the one presented herewith; its weight is 47.5 grammes. The service charge for the musket is 4.5 grammes (for the artillery carbine 2 grammes less); for blank cartridges 7 grammes are used. As 6.30 grammes are necessary to fill the space around the stem, the charge of 7 is ordered, that the rod may never touch the stem in loading. The vacant space between the powder and the ball secures room enough for any ordinary accumulation of dirt in long-continued firing, and no injury has resulted from it to any of the arms tried. Ball-cartridges are made with an extra piece of paper, forming a cup, to contain the powder; the ball and this cup are then enveloped in the ordinary folds of the cartridge-paper, and the ball end dipped in grease. In loading, the powder is poured into the barrel, the ball inverted, and inserted in the bore, all the paper torn off and thrown away, and the ball rammed home. Six cartridges are bundled together (with eight caps, in a special cylinder). In the alteration of old guns to this new plan, a stem of the proper size is screwed into the original breech-pin, and the old barrel grooved as above stated. To avoid the necessity of using the stem, a recent proposition has been made to use a ball charged at its lower extremity with powder (percussion, I believe), which, exploding with the charge of the gun, would swell out the circumference of the ball sufficiently to fill the grooves of the barrel. Experiments with this ball have been perfectly successful.

"In connection with this subject I will mention a novelty, exhibited at the national exhibition at Paris by Berger of St. Etienne. It is a musket-lock, where the number of parts is reduced to three. Its external appearance is the same as the present French musket-lock, so that the same lock-plate could be used. Reversing the existing action of the lock (where the tumbler is attached to the hammer, making necessary a sear-spring to equipoise the pressure of the main-spring upon the nose of the tumbler), to the hammer is attached a piece, acting as the sear; and the end of the main-spring has on it the notches usually on the tumbler. The upper arm of the spring has on the end a pro-

jecting point working in a circular slot in the hammer, which steadies it against the pressure of the lower arm. Thus, the hammer, spring, and lock-plate form the lock. The usual tumbler-screw prolonged holds the hammer upon the lock-plate, and attaches the lock to the stock, the front of the plate being held by the head of a fixed screw. On the outside of the lock-plate is a cylindrical projection, upon which the hammer fits. Through the centre of this the side-screw passes. On the inside of the plate the main-spring is attached, about the centre of its length, by a pin, and its lower arm bears upon a fixed stop on the plate to stiffen it. The exterior surface of the hammer is as at present; on its inner face is a circular projection, centring with the cylinder on which the hammer turns, and revolving in a bed in the lock-plate, of a depth equal to half the thickness of the plate. Near the outer edge of this projection is screwed permanently the piece acting as sear, which works in the notches on the end of the main-spring through a hole in the lock-plate. A groove in another part of the projection allows the projecting point on the end of the upper arm of the spring to work in it, passing through a cut in the lock-plate also. These two cuts in the plate are covered by the hammer. The hammer can be taken off when drawn to its full height, without the use of a spring-vice, thus effecting another economy in dispensing with this. With the hammer off, the lock can be thoroughly cleaned. This suggestion, due to an apprentice boy at St. Etienne, seems to me to have many merits to commend its introduction.

“An ingenious lock for small arms has been made at Delft, and is said to have been fired more than one thousand times without a failure. The lock consists of but one piece, a spring (acting also as the hammer); the cone is in the axis of the gun, on the breech-pin; the trigger forms part of the spring. One end of the spring rests in a notch forged under the barrel; by pressing down the other end, the trigger-notch catches on the guard-plate; by pulling back the trigger, the spring is released and the cap fired.”

Major Hagner also mentions that in the French armories it is the custom to repair defective gun-barrels by piecing them. This is done at all stages of the fabrication, even in cases where barrels burst in proof. He thinks this plan worthy of adoption, to some extent, in this country.

PERCUSSION-CAP MACHINES. — Major Hagner mentions a machine for making percussion-caps, which he says promises to work well. “The copper, in strips, enters the machine vertically, being fed in, by rack, at each end of a lever-arm, to dies, cutting the star and forming the cap (as with us), the cutters attached to the ends of a swinging beam, moved by an eccentric, so that a star is cut and cap made alternately at *each end* of the beam, or *one* every half revolution of the crank. The punches act horizontally, and a piston pushes the finished cap from one matrix as the punch enters to form the cap in the other. This secures, as with us, a freedom from clogging. The inventor had conceived and partly matured a plan for combining the filling and varnishing operations with this machine, the only instance that I saw in Europe where the idea of such a combination seemed to have been entertained at all.” — *President's Message, Part I.*

NEW NEEDLE-GUN.

EXPERIMENTS were made at Woolwich on Tuesday last with an improved construction of guns, patented by Mr. Sears. The invention is on the principle of a needle-gun, and is applicable to military muskets, carbines, rifles, pistols, and fowling-pieces, on the using of a cartridge of peculiar arrangement and composition. By this plan, the difficulty of furnishing troops with ammunition, so prominent an objection to the Prussian military musket used by the Fusileers in the Prussian army, is entirely obviated, and the soldiers are enabled to carry a greater quantity of cartridges, and are also able to make them for themselves with the greatest ease and safety, and effect a saving of upwards of twenty-five per cent. compared with the cost when percussion guns are used. A musket-stand was placed at a distance of four hundred yards from the butt where the target was put up, and a rifle, fitted on Mr. Sears's plan, was taken, and the mode in which it is loaded minutely explained to the officers who were present. The loading is a very important feature in the invention, as it can be effected without the least difficulty in any position of the body, whether lying flat on the ground, on foot, on horseback, or in the rigging of a ship, as it does not require that the gun should be turned, as is the case when a ramrod is used to drive home the cartridges with the common muskets of the service and with fowling-pieces. The cartridges used are very small, the great number of charges obtained, sixty out of each quarter of a pound weight of powder, being compared with the quantity used in the common ball-cartridges of English muskets. The ball is formed in the shape of a loaf of sugar, only more tapering at the point than the balls used by Mr. Lancaster and others. Mr. Sears's ball-cartridge is put into the breech of the barrel through a cavity in the under part of the stock of the gun, and requires no other exertion than the use of the thumb and forefinger of the right hand. A sliding, but strongly made groove, similar to the head of a bayonet, is then pushed forward, and renders the breech of the barrel air-tight, and not liable to be injured by any concussion. In the centre of the extreme end of the sliding groove is a needle, which is pushed forward sharply on the trigger being drawn, and is very effective in its operation, as was evidenced, only one cartridge having failed to ignite on drawing the trigger, out of fifty-four fired with Mr. Sears's guns. It was evident that the charge of powder for the cartridges was too small for a range of four hundred yards, or the person who fired was not acquainted with the elevation of the musket requisite to carry that distance, the first four rounds having fallen about one hundred yards short in every instance. The fifth and sixth rounds, on the musket having more elevation, entered the target. After trying several other rounds, the stand was removed to a range of three hundred yards from the target, and ultimately to two hundred yards' range. It was ultimately resolved that another trial should take place with an increased charge of powder. Mr. Sears's construction of gun appears very simple and easily used, and four rounds can be fired from it in a minute, which might be extended to five or six by those acquainted

with its operation, after a short practice. It differs materially from the Prussian military musket and all others loading at the breech; in the latter the smoke of the powder escapes, but in no instance was there the least appearance of smoke at the breech of Mr. Sears's gun. The explosive power of the gunpowder is so effectively employed as to leave the barrel as clean after firing fifty-four rounds as it was after the first discharge; and the gun, consequently, is not apt to get clogged, as is the case with common muskets. — *London paper, Feb. 28.*

MACHINE FOR PURIFYING SUGAR.

MR. R. A. BROOMAN of London has invented a new machine for depurating sugar and other substances. The principle of the invention is the employment of a centrifugal force, which throws the moisture out and suffers it to escape, while the substance from which the moisture is to be extracted is prevented from flying from the centre. The machine consists generally of a pan mounted on a shaft within a receptacle for the extracted matters. At the lower end of the shaft are two cone-pulleys, connected by a driving-band, to give a gradually accelerated motion to the pans. Loose pulleys are placed on top of the cones, to stop the motion when required, and the cones may be connected to the engine-shaft by spur-gearing to give them a steady motion. There is also a combination of pulleys by which the driving-bands are raised and lowered as required. Within the pan is a loose bag of a peculiar form for unloading, the outer edge being secured to the flange, and the inner one to a ring-nut fitting a screwed spindle, which is secured to the pan-shaft. To unload the contents, the nut is held while the spindle turns with the pan, carrying the nut and bag upwards, the centrifugal force of the pan filling the bag. The extracted matters are guided into the bag by a guard as the centrifugal force makes them impinge upon it, after which they are deposited in the receptacle, and, the nut being released, the bag runs down to load again. The rotating drum is double, consisting of an outside and an inside one, and its upper part has a central opening closed by a cover, through which the substances to be purified and dried are introduced, so as to rest upon a false bottom. A wire-cloth is fitted to the interior of the drum, to permit the free escape of moisture. The drum rotates on a spindle, and through its centre passes a hollow shaft, for the admission of steam at the top. The channel of this shaft is connected with the space between the drums by a pipe. The substances to be separated are placed in the drum, and the steam turned on, while at the same time a slow rotary motion is given to the cylinder, until all is heated, when the motion is increased, and the moisture is thrown out through the screen by centrifugal force. The moisture is received in the space below the false bottom, and drawn off by a pipe. Water may then be introduced for farther purification, and the process repeated. In some cases it may be advantageous to admit steam to the substance, and then some slight modification of the above arrangement is necessary.

A London paper states that by this process sugar, which formerly

took from three to five weeks to refine, is done in as many minutes, and that sugars altogether unsalable are converted into an article of considerable value. The *Philadelphia Inquirer*, speaking of this machine, states that "two hundred weight of sugar, of the dirtiest character imaginable, and as black as soot, was placed in it, and in six minutes it came out white, dry, clean, and sweet." — *Scientific American*, June 29.

IMPROVEMENTS IN MACHINERY FOR THE MANUFACTURE OF GLASS.

MR. WM. BLINKHORN, of Sutton, Lancashire, has patented some improvements in machinery to be used in the manufacture of glass, by which he proposes to employ a hollow casting-table, the upper part and sides being cast in one piece, with flanges, which are riveted to the bottom plate; a stream of water is to be kept running through this table, in the lower part of which there are ovens for the purpose of heating the water and the top plate to about 120° F., to prevent injury to the plate when the metal is first poured from the crucible on to the table. When, after repeated castings, the top plate of the table has been heated, the fires are raked out, and the temperature kept down to the required degree by the stream of cold-water running through, or by several jets caused to play against the under surface of the top plate. The rolling cylinder is supported above the tables on adjustable tongs, for the purpose of regulating the thickness of the plate, and is fitted on each side with guides for determining the width. The cylinder is made to travel to and fro on the table by means of a pitch-chain connected to its brasses, which goes round a pitch-wheel, driven alternately in opposite directions by the ordinary reversing gear, placed in front of the kiln, and actuated from a prime mover. To each side of the cylinder there is attached an arm, connected to a lever, which has a notch in the upper surface nearest the kiln, into which takes a projection on the under surface of a cross-sliding piece attached to a chain passing over a pulley, and weighted at the other end. The opposite ends of the levers are furnished with friction-pulleys, and the corresponding end of the table is fitted with inclined planes. At the commencement of working, the table is raised to the requisite degree of temperature, and the rolling cylinder drawn back to the end nearest the kiln, upon which the metal is emptied on to the casting-table. The cylinder is then made to travel over the metal from the kiln, carrying the sliding piece with it, which is raised above the surface of the plate. When it arrives at the end, the friction-pulleys ascend the inclined planes, and, by causing the notched ends of the levers to be depressed, liberate the sliding piece, which is drawn back by the reaction of the weighted chain, and thereby forces the plate into the annealing kiln. — *London Mining Journal*, Aug. 24.

IMPROVEMENTS IN THE MANUFACTURE OF GLASS WARE. — The Boston and Sandwich Glass Company have recently commenced the manufacture of glass bowls by machinery, of a magnitude that far exceeds in size and weight any heretofore made by glass manufactories in this

country. The bowls weigh about sixty pounds, are twenty-one inches high and twenty-two inches in diameter across the top. They have received the name of the Union Bowls, and, being made of pressed glass, can be afforded at a very moderate price.

MACHINE FOR PREPARING AND PRESERVING BUTTER.

THE *St. Louis Republican* states that Mr. E. H. Merryman has invented and patented a machine by which he is enabled to restore to its original sweetness the most rancid butter. It is also designed for preparing and packing butter. It consists simply of two rollers in immediate contact with each other, operated by a crank and spur-wheels. They are placed in a trough and partially submerged in water. As the butter passes between the wheels, every particle is brought into immediate contact with the water, which washes away the buttermilk as fast as it is pressed out. After this it is only necessary to salt and pack it away in close vessels, and it will be preserved sweet and pure for a long time. The machine occupies a space of about four feet by two, and a single person can work with it seven hundred and twenty pounds of butter per hour. Rancid butter put into it comes out completely divested of all rancid taste or smell.

CANDLE-MAKING APPARATUS.

MR. A. L. BROWN of New Haven has invented an improved apparatus for making mould-candles. The improvement consists in constructing the mould with a screw on the upper part, about two inches from the end, for adjusting and securing it to the frame, and a shoulder near the upper end, to support the tallow-table, and a hole to admit the wire which supports the wick; also in attaching all the wires to a slide worked by a jointed wire-handle, and governed by a guard, so that all the wicks may be evened by one motion of the hand, and then be all centred by another motion. There is also a smooth tallow-table, level with the tops of the moulds, to allow the tallow to be easily scraped off. — *Scientific American*, Feb. 9.

WEIGHING AND REGISTERING SCALE.

THE *Lafayette (Indiana) Journal* describes a new "self-weighing and moving-index discharging scale," for weighing grain, the invention of Mr. W. W. Bramble. It says: — "The frame which supports the scale-beam also supports a permanent hopper, made like those in common use, which receives the grain to be weighed. Suspended to the scale-beam is a box, which incloses the revolving hoppers in which the grain is weighed, and the machinery which controls the movements of the scale. There are four revolving cylindrical hoppers in this box, attached to a shaft, something similar to the boxes of an overshot water-wheel. Connected with the journals of this shaft, on each end, is a register, with a dial-plate or face similar to that of a watch. The dial-plate on one end is divided into three registers.

The hand of the first register is to mark four revolutions of the revolving hoppers, which, supposing each hopper to hold four bushels, will register forty-eight bushels. The hand of the second register marks at each revolution four revolutions of that of the first register, say forty-eight bushels each. And the third register tallies four revolutions of the second, which registers four times that of the first. The dial-plate or register attached to the other end of the shaft is to govern the number of bushels to be weighed. Say, if 2,000 bushels is the quantity to be weighed, set the hand of the register at that number of bushels, and when that quantity has been weighed, the scale will cease to weigh any more, until it is set again. From 12,000 to 25,000 bushels may be weighed in twelve hours, without any attention, if the receiving hopper is kept supplied. If a definite quantity is to be weighed, set the discharging register at the quantity, open the gate of the permanent receiving hopper, and whenever the revolving hopper is filled with the quantity it should hold, the beam rises, shutting the gate of the feeding hopper, the filled hopper turns sufficiently to empty, the next one takes the place of the one just filled, which, as it turns, by means of a flange attached to each of the wings of the hopper, lifts the gate of the receiving or feeding hopper, which, when filled, turns as before, and so on until the required quantity is weighed. The hoppers will only turn and register when filled with the exact quantity they are to hold, so that they will not weigh fractions."

NEW STEERING APPARATUS.

THE new steamship Asia, of the Cunard line, is supplied with the "Patent Safety Steering-wheel," recently invented by Captain Fayrer, of the Royal Navy, which "consists in the application to the steering-wheel of a friction-band, similar to that used in cranes, which passes round a projecting circumference inside the wheel, and is brought down to a pedal on the deck, by pressure, on which any amount of friction can be put on the wheel. It is not desirable that the helm should ever be a 'dead lock,' without the power of yielding a little to the shock of a very heavy sea, as that would endanger the carrying away of the rudder; an adjusting-screw is therefore provided, by which the amount of *ultimate* friction that can be put upon the wheel is regulated, and not left in the power of the steersman. A great advantage of this invention is the power which it gives of fixing the rudders of vessels lying in a tideway or harbour, and thereby preventing the continual wear on the pintals of the rudder, and, in time, the loosening of the stern-framing of the vessel." But the greatest advantage of this new apparatus is the security which it affords from those accidents which often occur to the helmsman on board large vessels, from the little power which they have to resist the sudden shocks caused by the sea striking the rudder, by which the helm is often taken out of their hands, and they are either thrown overboard or much hurt. We are told that, as applied to the Asia, this new apparatus works admirably. — *Boston Journal*.

CAPT. C. F. BROWN, of Warren, Rhode Island, has invented a new and ingenious improvement in steering apparatus for vessels. The head of the rudder-post is made of metal, with a helical groove running down on each side of it, and over this is placed a tube, with two feathers on its inside, fitting into the grooves. Over the top of this is another outside tube or cap, bolted by a flange to the deck, and on its top is the wheel, having for its axis a screw, which works into a thread opening in the second tube, and as the wheel is turned this second tube is raised or lowered, and its feathers, thereby working in the helical grooves of the head of the rudder-post, turn it round, and from one side to the other, thus operating the rudder and steering the vessel. The steering-wheel is horizontal, and there is an indicating pointer on the post-head, which, as it turns, points to an index, and enables the steersman to see every degree through which the rudder moves. — *Scientific American*, May 25.

NEW LIFE-BOAT.

THE *London Times* describes a new life-boat, the invention of Mr. W. Bonney. Its peculiarity consists in the mode adopted for giving it buoyancy. "This quality is communicated to the ordinary class of life-boats by the fitting of hollow tubes round the gunwales or thereabouts, and beneath the thowls. Mr. Bonney, while he does not give up this method, adds another and a more scientifically working plan to the old mode. On each side of the boat, from stem to stern, runs a triangularly shaped chamber, formed by dropping a perpendicular sheet of iron from the deck until it joins the bulge of the boat. Of this triangle the deck is of course the base, the outer shell of the vessel constituting one side, and the inner partition the other. The result is, that when the vessel is on an even keel, she floats just like any other craft; but, when she careens over, by the force of the wind or any other influence, the buoyancy of the lee chamber comes into play, and as the quantity of air forcibly submerged becomes larger the greater the heel, it follows that the stronger the careening impulse the greater is the resistance. From what we saw yesterday, and the explanations we heard given, it is evident that no vessel built upon this principle can, except under some very extraordinary circumstances, capsize. The quantity of air buried in the water, when heeling over, would prevent it, and would cause her, even after sailing on her side, to right herself as soon as the least decrease took place in the careening power. Ordinary boats may fill with water either by being dipped gunwale under by sheer force of wind or by shipping a sea. In neither case would the catastrophe be of material consequence to Mr. Bonney's gutta-percha cutter; and for this simple reason, that only a given proportion of her, that is to say, the space left between the inside walls, can fill; and that when this takes place the air-chambers, now brought into play on both sides, are quite sufficient, not only to keep her afloat and manageable, but to support her reasonably well loaded with people. We saw her yesterday filled with water, and with several hundred weight of ballast, besides that

of the man who steered her, tacking and veering about, none the worse for her fluid cargo."

SECTIONAL BOATS.

A NOVEL description of boat has just been completed at Liverpool, for the use of her Majesty's Consul at Fernando Po, on the West Coast of Africa. This boat is the invention of Mr. Macgregor Laird. The peculiarity of construction consists in her being built in sections, which can be put together, and made perfectly secure, without mechanical or skilled labor. The official report from Commander Bevis, R. N., to the Secretary of the Admiralty, states her dimensions and efficiency as follows:—Length, 68 ft.; beam, 12 ft.; depth amidships, 4 ft.; forward and aft, 6 ft.; tonnage, builder's measurement, 45 tons; total weight of iron-work, $4\frac{1}{2}$ tons; weight with wood-work, masts, sails, rigging, anchors, cables, and all complete, 8 tons. Displacement at 2 ft. draught of water, 20.89 tons. There are eight sectional pieces,—the heaviest of which is 16 cwt.,—joined together by angle-iron joints, lined with vulcanized India-rubber; the whole being secured by screw-bolts and nuts, so that her own crew, of forty-five or fifty men, can carry her over any neck of land and set her up again. "Her light draft of water is estimated at one foot, with her crew; with provisions, water, &c., for the same, at two feet. She is to pull thirty-eight oars, double-banked, fitted with three schooner-sails and square-sail, having, for night protection, iron stanchions covered with thin felt. She is also to be fitted with air-tight galvanized tubes as a life-boat. From her light draught of water, and general lightness, she is particularly well adapted for crossing the bars on the coast of Africa, where there is a short breaking sea; and for proceeding up the rivers, or to go in chase of slavers, as, from her construction, she must pull and sail very fast." The Superintendent of Emigration at Liverpool recommends similar boats for emigrant ships. — *London paper.*

NEW SOUNDING-LINE.

THERE has been lately deposited in the Naval Museum at Paris, the model of an ingenious sounding apparatus, invented by M. le Coëntre, who in 1841 commenced a series of experiments on board the *Africaine* frigate for testing the accuracy of his invention, which the several reports of the officers concur in stating to be complete. This new sounding-line consists of a hollow truncated cone, of copper bronze, $19\frac{1}{2}$ inches in height, about 6 inches in diameter at the base, and 2 inches at the summit. The metal is very thick, and upon one of the sides is placed a strip of glass, enabling the observer to read the scale, which is $11\frac{1}{4}$ inches in length. An endless screw, which is the axis of the cone, acts upon an index, or traverser. The screw passes through the upper part of the cone; and to the protruding portion, or shoulder, are attached two little wings, or fins, perpendicular to each other. Their inclination varies according as it is desired to obtain

more or fewer divisions of the scale, that is, to ascertain the depth in metres or fathoms. The little wings are protected by a pierced dome, immediately above which is a ring for the reception of the sounding-line. To the bottom of the cone is attached a cylinder of lead, of sufficient weight to carry it through the water. This lead is concave at the base, and is filled with grease, in order that the nature of the bottom may be ascertained from the portions which adhere to it. When the apparatus is cast into the sea, the resistance offered by the water from below upwards causes the little wings to open, and, from their vertical position, to revolve. The screw, of course, obeys the movement, and the index quits the zero point, and travels down the scale. As soon as the lead touches the bottom, all motion ceases, the instrument is drawn on board, and its result read off. M. le Coëntre's apparatus has been tried upon known soundings, and its results found to be accurate. It is considered by French naval men as being especially valuable, since it enables soundings to be taken either from steamers or sailing-vessels without decreasing the speed of the ship, as on the old plan, and, in fact, while going at the rate of eight or nine knots an hour, and in any weather, even sub-marine currents not operating prejudicially to its effective working. — *English paper*.

ALTITUDE INSTRUMENT.

MR. A. GIRARD, of Mobile, Ala., has invented a new instrument for taking the altitude of the sun, at any hour of the day, on sea or land, by its shadow, without an horizon. By adding to the angle given by the instrument the semi-diameter of the sun and its refraction, we obtain its true altitude, and by adding the declination at noon, the true altitude of the place where the instrument stands is arrived at, that is, if the latitude and declination are both north; if, however, one is north and the other south, the declination must be subtracted. — *Scientific American*, July 27.

THE ATMOPYRE.

MR. D. O. EDWARDS has devised a plan for substituting coal-gas and other combustible elastic fluids for coal-fires. It is well known that flame is a hollow cone, its exterior being formed by the evanescent particles of carbon, which, being for the moment precipitated in a solid form, after the combustion of the hydrogen, and raised to a white heat, give out light in virtue of that transient solidity. This occurs the instant before the union of the carbon with the oxygen of the atmosphere, and their conversion into carbonic acid, which forms an invisible pellicle round the flame. The temperature to which this carbonaceous shell is raised is very great, but as soon as it is engendered, it is carried away by currents of the surrounding atmosphere. It is the object of this invention, which was suggested by the Davy safety-lamp, to arrest and detain this heat. This lamp is a chamber, whose walls are perforated with minute holes, through which air and gas freely pass, while they are impermeable to flame. The incandes-

cent gas, in its transit through these apertures, is robbed of its heat, the flame is extinguished, and the heat is developed in the wire-gauze, which becomes red-hot. In the present invention cylinders of various sizes are made of a mixture of one third of china-clay with two thirds of common pipe-clay; they are perforated with numerous orifices, and have a circular opening at one end to screw on to a No. 4 gas-burner. This cylinder, or hood, is the converse of the Davy-lamp, the gas being inside instead of outside, and on its escaping through the holes and fire being applied, the hood in one minute becomes red-hot. A battery of these hoods placed in a circle, and covered with a case, is heated to an orange color, and a temperature has been obtained sufficient to melt the more refractory metals. For warming apartments, a battery of twelve hoods is inclosed in an earthenware case, which, becoming heated to 500° F., forms a repository of heat. This, in turn, is placed in an outer ornamental case. The products of combustion are carried off by a pipe into the chimney, while fresh air is supplied from outside the dwelling through a tube communicating with the space between the two cases, where it ascends, is warmed, and passes into the room through large holes in the top of the stove. The expense of such a fire is sixpence per day. It may be used for cooking, for refining gold and silver, for steam-engines, and various other purposes. — *London Mining Journal*, Sept. 21.

SOYER'S MAGIC STOVE.

AFTER various experiments, M. Soyer has succeeded in bringing to perfection his magic stove. The magic stove was exhibited to the public on Saturday and Monday last, and a more efficient, portable, clean, and ornamental cooking apparatus it is impossible to imagine. The whole apparatus can be placed in a hat, and the cooking is conducted on the dinner table, without smell, without smoke, and without even soiling the cloth. The apparatus itself is rather ornamental than otherwise. It consists of a round copper, in shape and size somewhat resembling a counting-house inkstand, with a furnace-opening, and a flue passing from this opening, near the bottom of one of its sides, through the middle and up the centre to the top; on this top is placed a frying-pan, stew-pan, sauce-pan, kettle, or coffee-pot. Adjoining the stove or copper is a vessel with two reservoirs for spirits of wine, or any other kind of spirit, — one at the bottom, the other at the top. To the bottom reservoir are affixed two burners with their wicks; one of them is placed opposite the opening of the flue in the stove, the other is under the other reservoir. In connection with the upper reservoir is a tube, or blow-pipe, passing from the centre of its apex, down by its side, under it, and opening in the wick that burns at the mouth of the flue. The spirit in the upper reservoir being heated by the burner beneath it, a gaseous vapor is generated, which, rushing out of the blow-pipe, and coming in contact with the burner at the mouth of the flue, is ignited and passes in a volume of flame through the flue, and fries, stews, or boils whatsoever is placed over it. It will cook 1½ lbs. of rump steak in five minutes. A little explanatory

book is given with it. And, to make every thing complete, M. Soyer gives receipts and instructions for the cooking of about a dozen and a half of dishes, by means of this pocket-kitchen of his. He has, moreover, fitted up a small box, in size and shape like a lawyer's deed-box, with a complete apparatus for cooking and sending up a dinner for twelve persons. The magic stove will go on cooking for about forty-eight minutes with one charge of spirits of wine, the cost of which is just fourpence halfpenny. We have partaken of chops and steaks cooked by the magic stove, and they are certainly far superior to those cooked by any of the ordinary methods. The heat is so intense, that the exterior of the chop or steak is at once carbonized, and thus the juices are retained without the chop being burned, so that it is at the same time crisp and succulent. — *London paper, May 30.*

GAS STOVE.

MR. W. S. WARD described to the British Association, at Edinburgh, a gas stove, the novelty of which consists in constructing it of iron plates in a vertical position, so as to expose considerable surfaces for the absorption of heat from jets of gas, and for the radiation of the heat. This apparatus is sufficient to raise the temperature of a moderate-sized room from 5° to 10° F., with a consumption of about three feet of gas per hour, costing about two pence for ten hours. The stove consists first of a sheet of plate-iron, to fill up the usual opening of a fire-place, with a hole through for a chimney, and two other plates of iron placed about three inches apart, and inclosed round the rim; near the bottom are perforations to admit air, and a small door with a burner, consisting of several small jets inside; when the gas is lighted, it heats the air inside, and the surface of the two iron plates; by this arrangement all unpleasant effluvia are conveyed away through an iron pipe made near the top, which leads into the chimney of the room. — *Civil Engineer and Architect's Journal, Oct.*

LAMPS FOR BURNING-FLUID.

At the meeting of the Franklin Institute, on Sept. 19, a report was presented from a committee appointed to examine some lamps for burning camphene, &c., the invention of Mr. S. E. Winslow, of Philadelphia. "The improvement consists in the employment of a double system of lamp-wick, instead of the single continuous wick used heretofore. One portion of wick passes down into the fluid, and, by capillary attraction, elevates the fluid to the top of the lamp; the other portion of wick passes only through the tubes of the lamp, and covers the lower surface of the movable top. When the top of the lamp is screwed down to its place, the two portions of wick are brought into close contact, and the fluid passes readily, by capillary attraction, from one to the other. When it is desired to replenish the lamp while lighted, the top with its portion of wick is removed, and placed at any convenient distance, this part of the wick retaining a sufficient quantity of the fluid to support the flame during the time oc-

cupied in replenishing, thus furnishing the necessary light for this operation." At the same time, the removal of the flame to a distance from the body of the lamp containing the fluid greatly diminishes the danger of explosion, as the explosion of this species of lamps results chiefly from the accumulation of a highly explosive vapor in the space above the fluid.* The committee, therefore, strongly recommend the use of these lamps. It is possible, however, that they may be more readily extinguished by a sudden movement than the old lamps.

COOKING BY GAS.

AMONG the novelties produced at the great agricultural meeting at Exeter, England, was one which excited great curiosity; it was the cooking of the monster joint, weighing 535lbs. For the first time in the annals of cookery, this was subjected to a new process of roasting, by use of an agent which has been discovered half a century, that is to say, gas. To gratify the curiosity of the public, it was placed in the middle of the castle-yard, resting upon a dripping pan, environed with bricks and surrounded by 216 jets of gas, and covered with sheet-iron. It took five hours to roast, and consumed 700 feet of gas of the value of 4s. 5½d. It weighed, after being cooked, 497lbs.; the dripping 23½lbs.; the osmazome 3½lbs.; thus losing by evaporation only 11½lbs. To cook this piece of beef by an ordinary fire would have taken fourteen hours.

IMPROVEMENTS IN VENEERING.

MR. JOHN MEADOWS has obtained a patent for improvements in veneering, which consist in effecting the union of the ordinary veneer in such a manner that it may be applied to irregular surfaces in one piece, instead of joining it at the angles and forming it in several pieces as usual. In illustration of this mode of applying veneers, a number of ogee-mouldings, joined with several curved and flat surfaces, meeting at sharp or right angles, are shown in the drawings, but a description of one will suffice for the whole. The frame or other piece of work to be veneered is prepared of the form required; and, supposing it to be first of an ogee-form, the veneer is laid on a bed of that form, placed in a machine somewhat like an ordinary screw-press. This bed is hollow, for the purpose of heating it by steam or other medium; pressure is then exerted by the screw on the frame, which is thereby pressed down on the veneer, and into the form required, between the heated bed and the frame or piece of wood to be veneered. So far, the process is very similar to the ordinary one. The next surface presented, or that adjoining the ogee, is a hollow curve, meeting in a right angle the edge of the ogee; the veneer is of sufficient width to cover this as well as any other portion of the frame service required. On the edge of the ogee-bed a hollow bolster is hinged, having a

* See *Annual of Scientific Discovery*, 1850, p. 192.

hand-lever, by which it is raised, so that the side presented to the veneer, which is of the curved form required, forces the veneer into the hollow, so as to effect complete contact with the whole of that surface; a suitable curved ratchet is provided, which sustains the bolster in its elevated position, the lever being such as to give sufficient pressure for the purpose; the veneer is thus bent over the angle and pressed into the curve. The next is a flat surface, united by a right angle to the hollow. Another pad or bolster is hinged by a lever to the bed of the press, which is now raised and sustained by a click taking into a curved rack; the veneer is thereby bent over the succeeding angle, and on to the flat surface, when the pad, to give the final pinch, is forced up by a screw; the pressure on the whole of the parts is allowed to remain till the adhesive material is sufficiently set for the purpose. The bolsters and pad have the levers and screws repeated at intervals, according to the length of the frame or surface to be acted upon. It will be obvious that other arrangements and forms of the parts will be required, according to the particular form to be veneered. Instead of using ordinary glue, the patentee employs parchment cuttings boiled down and mixed with whiting to the consistency of paste, which is applied uniformly on the back surface of the veneer, the bed being at the same time wetted with a brush. The object of employing a white cement is that the veneer, if thin, is not sufficiently opaque to hide the glue. An extremely thin sheet of brass is interposed between the veneer and the beds, and also a thickness of paper between that and the veneer to protect and render sharper the angles. One set of beds are made to suit a variety of designs by the application of paddings or filling pieces. — *London Patent Journal*.

IMPROVEMENTS IN STONE-WARE PIPES.

MR. B. A. BURTON has taken out a patent for "certain improvements in the manufacture of pipes, tiles, bricks, &c., from plastic materials." The object of this invention is to produce pipes and other articles from plastic materials of greater strength and durability, more regular in their structure, and of better finish than has ever yet been accomplished. The manner in which the inventor effects this object is by compressing the plastic materials by a process of rolling, which not only increases the strength of the articles, but also gives them a smoother surface, so that they are less liable to the accumulation of deposit, and, in the case of pipes, they offer less resistance to the passage of fluids.

The machine for making pipes consists of a vertical framework, supporting two clay cylinders, so arranged that they can be brought alternately below the screw and piston, for the purpose of forcing the clay through the dies, by which arrangement one cylinder is being filled while the clay in the other is being forced through the die. To the centre part of the die there is attached a mandril, the lower end of which comes just below the centre line of four rollers, arranged at right angles, so as to leave a circular aperture at the centre, whose bearings are supported by a cast-iron frame. The rollers are driven

by a wheel keyed upon the end of the shaft of the fixed roller and three pair of bevel-wheels. The bevel-wheels are driven by a pinion keyed upon the end of the main driving-shaft of the machine, which shaft also gives motion, by means of an upright shaft and suitable gearing, to the screw, which forces the clay contained in the cylinder through the die. The rollers are thus driven in the same direction and with the same surface velocity. The process of manufacturing pipe according to this invention is therefore as follows. The clay, as it is forced through the die in the form of a pipe, slips over the mandril. The length of pipe required is then cut off, and afterwards drawn by the motion of the rollers over the end of the mandril, whereby the particles of matter forming the pipe become compressed to such an extent, that, when baked in the usual way, they have been found, by repeated experiments, to be upwards of 75 per cent. stronger than pipes made from the same clay, but manufactured in the ordinary manner, besides being better finished in every respect.

Instead of compressing the pipes immediately after passing through the die, if the weather or the consistency of the clay render it desirable, they may be allowed to stand for a day or two. In cases where the pipe is to have a taper hole, a mandril is used made taper at the point, the mandril being gradually withdrawn by a screw or other suitable means, during the time the pipe is passing between the rollers. When the article to be compressed is not of a circular form, the number and position of the rollers are so changed as to leave the aperture at the centre of any shape required, instead of circular, as above described. In this way oval pipes, stair steps, &c., are formed, and by having the rollers engraved with a device it will be impressed upon the article. The hollow bricks or tiles are formed by forcing clay through a die of suitable form, and afterwards compressing the clay, by passing it between four rollers, two of which are turned of such a form as to produce a rebate on the edges of the bricks; the other two being engraved on their peripheries, so as to produce on the sides of the brick or tile any desired device. The ends of the brick are rebated afterwards in a separate machine. Another part of these improvements relates to the mode of making bends for pipes, and consists in so constructing the die that a bend of any required curve can be produced, simply by forcing the clay through it, whereby the moulds heretofore used in making bends are dispensed with. — *Civil Engineer and Architect's Journal*, Jan.

IMPROVEMENTS IN FIXED AND REVOLVING LIGHTS.

THE *London Civil Engineer and Architect's Journal* contains a description of a "new dia-catoptric instrument for increasing the intensity of the light in revolving or fixed lights." The instrument consists of three parts, a paraboloidal mirror, having the conoidal portion behind the perimeter cut off, and its place supplied by a hemispherical reflector, whose centre thus coincides with the focus of the paraboloid, while in front of the flame is placed an annular lens, subtending, at the focus of the paraboloid, the same angle as that which

is subtended at that point by the greatest double ordinate of the reflector, and having its principal focus coincident with that of the paraboloid. This instrument should theoretically produce the most intense light yet derived from any given flame, as it incloses and parallelizes each ray of the whole sphere of light, so that none are lost by divergence between the lips of the reflector, whereas at present not much less than one half of the light is lost. This combination may also be applied, *mutatis mutandis*, to the illumination of half of the horizon of a fixed light, by means of a single light; the only difference being the substitution of two truncated parabolic conoids for the paraboloid, and a refracting belt for the lens.

ARTIFICIAL PRODUCTION OF ICE.

THE *Scientific American* for Sept. 28 describes Dr. Gorrie's machine for the artificial production of ice.* He employs two force-pumps, which are the principal parts of the machine. Into the pump for the condensation of air, a smaller pump injects water in a fine shower, while the air is condensing, which thus absorbs the heat of the air that is given out in the act of compression. Between the condensing and expanding pumps there is an air-reservoir, which is of considerable size, and made like a steam-boiler. This vessel is intended to receive the condensed air and retard its passage, so as to afford time for its effective cooling, and to act as a magazine of force for working the expanding-engine. The expanding force-pump is the principal and most interesting feature of the whole, because it is the agent in which the expansion of the air and the production of cold first take place. All the other parts must be nicely adjusted in proportion to this part, for the making of the ice economically. The absorption of the heat is accelerated by immersing this vessel in water, and causing a jet of liquid to be thrown into its interior, as into the condensing-pump. This liquid is not congealable, and is withdrawn from a larger, though properly proportioned, quantity, contained in an insulated cistern, into which, after performing its office of imparting heat to, or, in other words, absorbing cold from, the expanding air, it is returned through the eduction-valves of the engine. As the liquid of this cistern has its heat diminished at every stroke of the engine, by the abstraction of the jet at one temperature, and its return at a lower, it is practically a reservoir of cold. Cold of an intensity of even hundreds of degrees below the atmosphere may be obtained by this process, but experiment shows that the temperature of the cistern most favorable for the rapid production of ice is at about 10° F. The expanded air partakes of the same temperature as the cistern, and therefore, at 10° F., leaves it charged with a high degree of cold, which the economy of the scheme requires should not be wasted. Instead, therefore, of being allowed to escape into the atmosphere, it is directed through an apparatus,—made like a brewer's refrigeratory for cooling worts,—around which is placed the water it is intended to

* See *Annual of Scientific Discovery*, 1850, p. 76.

prepare for congealing. It has been ascertained that pumps of a cubic foot capacity, worked at a temperature of 90° F., and fifteen revolutions a minute, are adequate to making a ton of ice per day.

COOLING THE ATMOSPHERE OF ROOMS IN WARM CLIMATES.

PROF. PIAZZI SMYTH detailed to the British Association, at Edinburgh, a method proposed by him for cooling the atmosphere of rooms in tropical climates. It is an application of the well-known property of air to increase in temperature on compression, and diminish on expansion. A compression of one fourth of an atmosphere is found to be sufficient. The following arrangement of the machinery has been adopted, for a one-horse power, which may be expected to furnish a room with about eighty cubic feet of air per minute, cooled 15° to 20° below the atmosphere outside. A double-acting air-pump, nine inches in diameter, and eighteen-inch stroke, making sixty double strokes per minute, with a jacket of cold water round the cylinder, to mitigate the heat of friction, forces the air into the lower end of a coil of copper tubes, contained in a tub of water, three feet in diameter and five feet high, where the cooling is effected. At the upper end of the tube is a safety-valve, permitting an escape of the confined air, when it exceeds seven pounds on the square inch, into a larger tube, which at once conducts the now cooled air into the desired apartments. The power used to work the pump may be steam, water, or animals. The tendency to unpleasant moisture in the cooled air may be corrected by making the tube, which conveys the cooled air into the room, pass through a still colder vessel of water, so that the moisture will be condensed on the inner surface of the metal. This vessel of water may be kept cool by salts or other means. Thus we compress air into a closed vessel, which is a good conductor of heat, when the air rises at first to a degree proportionate to the compression, say 50° F. above what it was before. If we began with air at 100° , it would now have risen to 150° , and would by degrees give off the extra heat to the water surrounding, and, if the air is then allowed to escape, it will fall again to 50° below 100° , or to 50° F. If it were allowed to escape immediately, obviously nothing would be gained, but by carrying off the extra 50° by conduction and radiation, while the air is in a compressed state, we evidently reduce the temperature as stated. This method is considered particularly applicable to hospitals in India and other tropical climates. — *Civil Engineer and Architect's Journal*, Sept.

MODE OF CONVEYING THE COCHITUATE WATER BENEATH A NAVIGABLE STREAM.

In conveying the Cochituate water from Boston to East Boston, it became necessary that the pipes should be carried beneath the navigable waters of Chelsea Creek, which is about 1,600 feet wide and 21 feet deep, in the channel, at low water. The mode devised for effecting this by the engineer, Mr. W. S. Whitwell, is very ingenious.

He adopts a peculiar and novel flange-joint, flexible only in a perpendicular plane, but so secure as not to need a wooden frame to accompany the pipe. The adaptation of this joint to the purpose, and its strength, are quite admirable. The distance between the joints is 31 feet 4 inches, and each section consists of three pieces of twenty-inch pipe, one inch and a half thick, and with flanges two inches thick, securely bolted together. These three pieces of pipe weigh together 3,300 pounds, and each joint weighs 3,800 pounds, the size of the pipe being considerably enlarged at the joint. The opposite sections of the joint meet on a perpendicular plane, parallel with the axes of the portions of pipe on each side of the joint, and move upon a leather packing, which is placed in a groove between the two flanges. One of these flanges is so much wider than the other as to have a cap or ring bolted to it, which incloses and holds the other, and thus constitutes the joint. The strength of this arrangement is obvious, and its tightness has been tested by trial, under a pressure of 250 pounds to the inch. The pipe when lowered is to be placed in a trench, which has been dredged in the bottom, and then covered with clay and gravel. About 500 feet of the channel is to be crossed in this way, and for the remainder, which is about 1,100 feet across the flats, the pipe is to be inclosed between rows of piles, so low as to pass beneath the wharves, when they come to be built. — *Boston Chronotype*.

APPARATUS FOR PREVENTING THE BURSTING OF WATER-PIPES FROM FROST.

MR. ALEXANDER MACPHERSON, of Leith, read a paper to the British Association, on the bursting of water-pipes from frost. After referring to the various plans which have been adopted for preventing this inconvenience, he says that the only really practical means of so doing is to keep the pipe empty, and the means at present of effecting this is to place two cocks on a low part of the supply-pipe, and by the one to shut off the water, and by the other to empty the pipes. But to render this plan of any avail, great watchfulness is necessary; and the consequence is, that even where the cocks exist, they are rarely used in time. "Reasoning on this," Mr. Macpherson goes on to say, "I have conceived the possibility of employing some self-acting apparatus, which, on the approach of a low degree of temperature, would of itself shut off the water and empty the pipe; or, in other words, of having a machine so constructed and regulated, that it would shut a cock before the freezing-point of water is reached, and open it when the temperature assumed its normal state." This requisite motive-power was first considered attainable by mercury confined in a bulbous glass vessel, acting as a barometer, with the difference of having a cylinder and piston. The next was suggested to Mr. Macpherson by Sir David Brewster, and consisted of employing the expansion of metallic rods, on the principle of the pyrometer. But his experiments led him to the result, that the freezing of pipes depends on their capacity for conducting heat. Thus, copper, as a conductor, is to lead as five to one; and therefore a determinate quantity of pure distilled

water, confined in a copper tube, was invariably frozen before that in the lead. The expansion (about one ninth) consequent on its crystallization, is applied, by a simple mechanical arrangement, to elevate a piston and shut a cock, while the water in the lead pipes is still fluid.

COUPLING FOR PIPES AND HOSE.

Mr. A. H. BROWN, of Albany, has invented a new coupling for hose and pipes, by means of which a connection between two pipes or pieces of hose is effected by a single motion of the hands. The coupling consists of a hollow metal ferrule, attached to the hose in the usual manner. This ferrule is enlarged at its other end, so as to form a cylindrical-shaped cup or hollow box, the edge of which is sufficiently thick to form a firm bearing against the flat, corresponding edge of the other coupling. This latter is a hollow metal ferrule, of equal bore to the first one, and its extremity is enlarged so as to form a flange, equal in diameter to the first coupling. The edge of this flange is turned at right angles to its axis, so as to bear truly against the edge of the other coupling when the two are united.—*Albany Cultivator*, Sept.

REGISTER HYGROMETER.

At one of Lord Rosse's scientific *soirées*, Mr. Appold exhibited his register hydrometer. This instrument, with a variation of one degree in the moisture, opens a valve capable of supplying ten quarts of water per hour, delivering it to pipes covered with blotting-paper heated by a gas-stove, by which the water is evaporated until the atmosphere is sufficiently saturated and the valve thereby closed. A pencil registers the distance the hygrometer travels.

HYDROSTATIC LOG.

At the meeting of the Royal Society, on Feb. 7, Sir Francis Beaufort, on the part of the Lords Commissioners of the Admiralty, communicated a description of a hydrostatic log, the invention of Rev. E. L. Berthon. Its object is to obtain a register of the speed of ships, by a column of mercury, in such a manner that the height of the column shall depend upon the velocity alone, and not be affected by any disturbing causes. The principle embraces that of Pitôt's tube, inasmuch as the force of the resistance due to the velocity is communicated through a small pipe, projecting into the water below the bottom of the ship; this force, acting upwards, compresses a portion of inclosed air in a small cylinder, which air, communicating by means of a little pipe with the bulb of a glass tube, bent like a common barometer, raises the mercury in the tube by depressing it in the bulb. The action of this single column of water and air upon the surface of the mercury in the bulb alone must depend, not only upon the resistance due to the velocity, but also upon the distance of the cylinder from the water-line, which varies with every sea, and it is therefore

necessary to find a compensation. The inventor thinks he has found a perfect one, which consists in applying a second column of water and air to press upon the other surface of the mercury, that in the glass tube. This second column is precisely like the first, as regards the pipe and cylinder, and communicates with the sea by an aperture or apertures, presented in such a direction that the velocity does not produce any increase of pressure. Thus the mercury in the indicator is placed between two columns of water and air, which are always equal to each other in length, and the mercury rises according to the difference between the pressures upon its two surfaces, the result of resistance or velocity alone. The air-pipes may be conducted in any direction, and the indicator, which swings upon gimbals, may be placed in any part of the ship. The two water-pipes are conducted into one in the bottom of the ship, divided into two separate chambers for the different forces. The true course, or leeway of the vessel, is also indicated upon a horizontal segment divided into degrees, over which a needle is moved by a rod connected with the above-mentioned double tube ; and the whole is kept continually in the true direction of the ship's motion by a float or vane attached to the lower end of the tube in the water. — *Brewster's Philosophical Magazine, July.*

WATER-METER.

AT the meeting of the Scottish Society of Arts, on April 22, Mr. F. A. Bucknall described a new meter, designed for the measurement of the supply of water to private dwellings, &c. It consists chiefly of a fan-shaped bucket-wheel, revolving within a cylindrical case, and kept water-tight by means of a packing of India-rubber, leather, or other elastic substance, supply and delivery pipes, and wheel and pinion-gear, which is connected with an index-plate. The revolving action of the meter is maintained by the gravity of the wheel being constantly greater on the one side than on the other, owing to the continuous running off of the water from the opposite side to that at which it is supplied. The meter is only in action while the water is running off. — *Civil Engineer and Architect's Journal, July.*

SELF-REGISTERING TIDE-GAUGE.

MR. MEIK has described to the Scottish Society of Arts a new self-registering tide-gauge, lately erected in Sunderland Harbour. A well, carefully boxed in, and of exactly similar depth to the water on the bar, is made below the building containing the apparatus. Within this well, in an interior pipe or trunk, and rising and falling with the tide, works a float suspended by a copper-wire cord, which is carried over a spiral cone fixed in an upper story of the building. By the simple arrangement of a wheel and pinion at the opposite end of the axle to which the cone is fixed, a web of wire-gauze works on two rollers fixed at its upper and lower ends. The lower roller is regulated by the movement of this wheel and pinion, the upper one by a balance-weight attached to a copper-wire cord, which also passes over

another spiral cone, having at the extremity of its axle a second wheel and pinion similar to the first. As the float moves with the tide, the wheels and pinions connected with the cones, over which the cords of the float and balance-weight respectively pass, move the rollers on which the gauze web travels. On this web are painted in large figures the various depths from high to low water; and, as the web works, two points on it indicate the number of feet and half-feet on the bar at any hour of the tide. At night the figures are lighted up. The apparatus occupies so little space that it can all be contained and worked in a column or pillar without any other building. — *Civil Engineer and Architect's Journal*, March.

IMPROVED FILTERS.

DR. E. WATERS, of Troy, N. Y., has invented and patented a new and improved filter for the use of druggists and chemists, which is designed principally to prevent the leakage and rupture so common when a large filter is filled with a heavy substance. The filter is manufactured of cotton and woollen, so combined as to render it extremely porous, and at the same time capable of filtering clearly. The usual difficulty of filters wearing away at their points has been obviated by inserting, during the process of manufacture, at the extreme end of the cone, a small piece of paper composed of entirely different materials, so strong in texture as not to give way by any ordinary chafing or pressure. This article supplies a desideratum long felt, and we understand that a paper-mill in Troy is now exclusively engaged in the manufacture of these filters. — *Editors*.

IMPROVEMENTS IN DISTILLING SALT WATER, AND IN VENTILATING VESSELS.

JAMES MURDOCH has secured a patent in England for improvements in converting sea-water into fresh, and for ventilating ships. The patent is also applicable to the evaporation of liquids, and to the concentration and crystallization of sirups and saline solutions. These improvements consist in the adaptation to the top of an ordinary ship's boiler, which is filled with salt water, of a pipe, which descends into the hold and opens into a vessel contained in an outer casing filled with cold water. This vessel is fitted with a number of vertical tubes in communication with the descending pipe, and all provided inside with a number of horizontal disks of wire-gauze. It terminates at the bottom in a zigzag pipe, which passes through the side of the cold-water cistern and opens at the top underneath an exhausting pan. The upper part of the boiler is furnished with a perforated tube, which admits atmospheric air. When the fan is set in motion, the air and steam generated in the boiler are drawn together down the vertical pipe, through the tubes and the wire-gauze disks placed therein. The steam is condensed in its passage and rendered pleasant to the taste by mingling intimately with the atmospheric air, which is exhausted by the fan, and thereby discharged. The ship may be ventilated by

means of this fan by connecting a perforated pipe, placed underneath the middle deck, to its discharge. This pipe may also be connected to a second perforated pipe, placed on the lower deck, and connected to a vertical pipe which communicates with the atmosphere.

An apparatus similar to the one just described, but without the condenser, may be applied to the concentration and crystallization of sirups and saline solutions, — the form of the boiler being, of course, modified so as to assume the appearance of the ordinary fan; and in some cases the bottom is made corrugated, to form continuous zigzag channels, through which the steam circulates, for the purpose of increasing the heating surface. — *Hunt's Merchants' Magazine*.

Apparatus for Filtering Sea-water. — M. Cardan has presented to the French Academy a description of a new filter, intended to render sea-water drinkable. The apparatus consists of a siphon, the long tube of which is filled with powdered charcoal. The author states that sea-water in traversing this siphon loses its nauseous savor, and that the saline taste which remains is scarcely to be detected after mixing with wine. — *London Athenæum*, July.

CENTRIFUGAL PUMP.

THE *Scientific American*, for Jan. 26, describes a centrifugal pump, the invention of Mr. Schmidt, of New York. There are two circular flanges, which are bolted together, and form a hollow ring, within the circumference of which are two disks also bolted together, so as to form a hollow chamber within this hollow ring. This ring has an orifice for discharge, to which a pipe may be attached, and a pipe from a lower orifice on the other side communicates with the water in the well or other place. A shaft rendered air-tight runs through the pump, and, being connected with a pulley set in motion by a band, it causes to revolve the arms of the pump, and thus forces up the water. The ends or blades of the pump-arms run in the hollow ring, while the arms themselves revolve between the sides of the disks. They are fitted to run with ease, so that the passages do not get clogged with sand, gravel, &c. This pump is stated to have been adopted at several of the works of the government. They can be made capable of discharging from 5 to 5,000 gallons of water per minute.

NEW PUMP FOR MINES.

SOME experiments have recently been made at the factory of Messrs. Donkin & Co. on a new pump, designed for raising water from mines or other deep levels, by direct action, without the intervention of main-rods, buckets, plungers, or valves. The machine used for showing the action of the pump was a one-horse power Bishop's disk engine, which possesses the extraordinary character of being applied either as a steam-engine to drive machinery, or of being driven by other machinery, to form a pump; it consists of a short cylinder, placed longitudinally, in which a disk with a projecting arm vibrates with a rolling motion. It was actuated by a steam-engine of similar form.

On the disk being set in motion, an immediate vacuum is formed at the induction-post, to which the windbore, or suction-pipe, is securely fixed; the water now rushes up, and fills the space between the cylinder and disk, which continues until the disk is opposite the delivery point, when the contents of the cylinder are forced out up the column, at the same instant the vacuum is forming on the opposite side, and a fresh supply is following that which is being delivered. The column used was a two-inch pipe, about forty feet high, and the water was ejected in a solid, continuous stream, with the greatest ease, at a velocity of two and a half feet per second. A large pump on this system is in daily use in Yorkshire, draining a marsh, throwing a continuous stream of ten tons of water per minute. — *London Mining Journal*, June 22.

DIVING APPARATUS.

THE *Farmer and Mechanic* for June 20 describes a new diving apparatus, the invention of Mr. Kennish. It is constructed of sheet-iron about one fourth of an inch thick. It is about seventeen feet high, twelve feet long, and ten feet wide, and has in the centre of the top an aperture or man-hole, on each side of which are three valves, with leathern hose-pipes for admitting pure air and carrying off that which has become foul. It contains internally two main divisions, which do not communicate, the inner one being devoted to the operations of the divers, and the outer to the purpose of lowering or raising the vessel in the water by means of air. These divisions are both open at the bottom. In working, the air is injected into the inner division by means of an air-pumping machine, and thus the water is prevented from rising in it. The air in the outer division is allowed to escape till the water rises in it to a certain point, thus destroying the buoyancy that would otherwise exist, so that the buoyancy of the inner division is counteracted by the weight of the materials and ballast. A rope serves to alter the distance between the bed of the river and the bottom of the vessel. To raise the vessel, air is injected into the outer division and the buoyancy thus increased. When the vessel reaches the surface the divers escape through the man-hole, and the vessel remains in the water ready to be towed to any other spot.

NEW AIR-SPRING FOR DOORS OR GATES.

MR. GEORGE BEATTIE has described to the Royal Scottish Society of Arts a new air-spring for shutting doors and gates, opening one or both ways. This is not a spring, properly so called, but simply a counterbalance, by means of the pressure of the atmosphere made to act towards a vacuum, the resistance being uniform throughout the travel of the door. The air-spring consists of an iron box and cover let into the floor, which contains a vertical axle supported at the bottom in a hollow cup, and furnished at the upper end, which projects above the floor, with a shoulder and lever-hinge for carrying the door on this shaft, and within the box is fastened a horizontal wheel, which

is toothed upon a portion of its circumference. On each side of this wheel is a rack, attached to a piston, which is made to fit tightly into a cylinder by a cap-leather. In the under side of the cylinder is another valve communicating with an exhausting chamber, and on each side of the racks are guides for the piston. The teeth of the wheel are made to take in either of the toothed racks according as the door is opened one way or the other, so that the piston will be drawn along the cylinder, leaving a vacuum behind, at a uniform and regular degree of resistance, until the door is released, when the unbalanced pressure of air upon the face of the piston will cause the door to resume its original position. The use of the valve communicating with the outside of the cylinder is that, in case of a leakage of air behind the piston, it shall be driven by the return of the piston through it to the outside. The use of the exhausting chamber and valve communicating with it is, that a portion of the leakage air or oil, which cannot be discharged by the valve leading outwards, escapes into the exhausting chamber, which allows the piston to get to the bottom, and to bring the teeth of the rack in hard contact with those of the wheel, and thereby keep the door steady and in its proper place when shut. The box requires to be filled with lard or sperm oil to seal the piston, and keep the whole lubricated. — *Civil Engineer and Architect's Journal*, May.

THE OROGRAPH.

PROF. LOCKE, of Cincinnati, in a letter to the *Boston Journal*, describes a new instrument with the above name, which, if it proves to be all that is claimed for it, will be of great value to the engineer. The great object to be attained in making a survey for a road is to draw upon paper, to a determinate scale, the profile of the line of survey, from which correct estimates can be made of the amount of excavation and embankment, &c., necessary for the construction of the road. This profile represents the distances of prominent points and their relative heights or differences of height. The data required to make this profile are, at present, obtained only by a very slow and laborious process, calling for a great degree of skill and science on the part of the principal operators, besides the services of several assistants. To reduce to paper the results of these labors becomes also a very tedious undertaking. By this instrument, the profile is drawn accurately upon a web or fillet of paper during the progress of the survey. A carriage is mounted upon wheels accurately made, the revolutions of which, when drawn over the ground, determine precisely the surface measure or travelled distance, as is done by the well-known perambulator or circumferentor. This distance is registered by one part of the mechanism when required. A fillet of paper is drawn along under a stationary pencil or pen, by means of wheelwork, set in motion by the revolution of the carriage-wheels. The velocity of the last wheel in this train is regulated by means of friction face-wheels, having plain and smooth surfaces, which have their relative diameters increased or diminished by the movements of a mercurial level and floats, or a pendulum,

or any similar mechanical indicator of level or perpendicularity. This level, by always maintaining its position with reference to the horizon or line of true level, affords a means of measuring vertical angles, just as the magnetic needle serves to measure horizontal angles. The motions of this level, as the carriage passes over irregular surfaces of ground, are communicated to the carriages of the friction face-wheels, and consequently regulate their velocities. Thus a given number of revolutions of the wheels of the carriage moves the paper farther, and of course the pencil draws a longer line, when on level ground than when either on ascending or descending ground. The locality of any particular points is marked at the time of passing them upon the line thus drawn, by simply pulling a lever, which marks upon the paper a line across the base-line or line of distance. The distance of any two of these points can readily be determined by dividers and a scale of equal parts. Another pencil is mounted so as to traverse in a line at right angles to the direction in which the paper moves. When this pencil is held stationary it draws a line upon the paper parallel with that drawn by the other, representing level ground; and it represents rising ground when it recedes from the other pencil, and falling ground when it approaches it. The steeper the elevation of the ground, the greater must be the velocity with which it approaches or recedes from the other pencil. The several movements of this pencil, backward and forward, are produced by means of friction face-wheels, differential screws, &c., deriving their motion from the wheels of the carriage, and modified, as in the first case, by the level or pendulum. There are many conveniences combined in the instrument, such as scales of distance and the numbers of the stations printed upon the paper by the mechanism itself; signal bells, to give notice of the approach to a station, &c. The engineer can, at a glance, in any part of the survey, tell the distance he has come, and the difference of level of any points in the survey. Messrs. Sellers and Whetstone, of Cincinnati, are the inventors.

INTEGRATING ANEMOMETER.

A SHEET of plain paper, placed in the instrument, under a registering pencil, is moved forward by rotating, hemispherical fans, at the rate of one inch for every ten miles of air that passes; this same pencil, having a lateral motion given to it by a vane, records the point of the compass from which the wind blows, and a clock-hammer, descending every hour, strikes its mark on the margin of the paper, to express the time. Thus, in a single line, are given the length of the current, its direction, and the time occupied in passing a given station. — *London Athenæum, Aug.*

NEW METHOD OF CONSTRUCTING GATES AND DOORS.

A MR. SHEPARD has invented a new method of constructing gates and doors. Instead of hanging them in the usual way, by hinges, or running them on wheels, he suspends them to iron bars extending

over the gate or door. Attached to the top of the gates are two wheels, which rest immediately on the top of the bar mentioned. When it is necessary to open the gates or door, the bar is raised a little in the centre of the doorway by turning a key round and round, which unlocks the gate, and at the same time raises the bar sufficiently to form an inclined plane, upon which the gate or door, by means of rollers or wheels, runs back by its own gravity, into a suitable recess in the piers or wall at each side, and thus opens the gateway clear of all obstruction. When it is desired to close and lock the gates, the bars upon which they hang are depressed a little at the ends, and the gates run along the bars until the gateway is closed. The London and Northwestern Railway Company have adopted this plan at one of their stations, and find it to answer much better than the ordinary mode, but one man being needed to open and shut the gates, while by the ordinary plan it required six. It is recommended to be used in all cases, from the ponderous gates of a fortress or railway station down to the highly finished door of a mansion.—*Herald's (London) Journal*.

EFFLUVIA-TRAP.

MR. C. MARSDEN has invented an effluvia-trap, which well answers its purpose. It consists of a drum, with four receivers or buckets, caused to revolve by the weight of the matters falling into one of them, when it instantly empties itself, and another bucket is ready to take its place. It is impossible for this trap to get choked up or for any effluvia to escape.—*Civil Engineer and Architect's Journal*, June.

NEW RAT-TRAP.

AMONG the patents issued in June last is one for an invention by Mr. Stevens of Maryland, whereby he has endeavoured to bring the science of optics to aid him in constructing a trap for catching rats. In this new trap a mirror is so arranged that the rat which looks at the bait shall see his own image reflected in such a position as will lead him to believe that a second rat is trying to get before him in seizing the bait; and when the first rat has been caught, his image will be reflected by a mirror, so that the next rat who shall look at the bait shall see two rats apparently striving to seize it, thus decoying him upon the turning table, which yields to his weight and precipitates him into the body of the trap.

MANUFACTURE OF GOLD PENS.

THE following interesting history of the origin and description of the process of manufacturing gold pens we copy from the *New York Tribune*:—

“Mr. John Isaac Hawkins, an American by birth, though for nearly forty years a resident of Europe, claims the original invention of the project of so forming a pen from gold as to render its point, or nib,

thoroughly indestructible. The perfection of his invention dates back to about the year 1834. Mr. Hawkins at that time had been, for nearly thirty years, seeking the hardest material in nature which was capable of being soldered to gold in quantities so small as to allow of a fine and smooth point, which might be cleansed with the readiness of a quill. He had, during many years, manufactured specimens of durable pens from various minerals and precious stones, but these all proved deficient. Some were made of rubies set in gold sockets; but here the nibs were clumsy, could not be easily freed from ink, and there was a sad want of elasticity in writing with them. Other contrivances equally failed, some in one way, some in another. All these appeared to be difficulties which were not to be overcome. The next essay was with diamond powder, coarse and fine, cemented inside the points of quill pens; but the particles were dragged out, by degrees, and a sensation of roughness caused thereby. The quill also became warped, and the whole was thereby rendered useless. In 1833, after a multitude of such experiments, the inventor became aware that Dr. Wollaston had sent to a ruby-pen manufacturer in London sundry specimens of rhodium and the native alloy of iridium and osmium, minerals found in combination with platinum, with the request that a pen might be formed from each. Accordingly, a few were made, but from the rhodium alone, the iridium being returned to Dr. W. by the manufacturer, with the remark that it was too hard to be wrought into figure. Here, then, was exactly the thing for Mr. Hawkins. Justly considering that, if the hardness of the new mineral were really so great as represented, it was eminently calculated to meet the want which he had experienced, he was led to commence his experiments anew. Entering upon the investigation with renewed care and deliberation, he prosecuted it until he obtained that result for which the writing portion of the civilized world are now so much indebted to him. A great point was to be gained in determining the relative degrees of hardness of the mineral he had employed, as compared with the newly discovered one. To ascertain this, Mr. Hawkins contrived a lathe capable of giving to the mandril 10,000 revolutions per minute; upon which was placed a lap of two inches diameter, running 5,000 feet per minute, or 833 feet every second. Diamond dust being then placed upon this lap, the minerals were severely tested. A bit of the iridium held against it was slightly abraded in five minutes; a ruby was cut away to the same extent in about *one third* of the time. This experiment was decisive, and abundantly satisfied Mr. Hawkins that the grand object of his endeavours had at last been reached. From this time, the manufacture of 'durable' pens went on rapidly with iridium alone. Of course many difficulties were encountered; but the inventor finally succeeded, to his own entire satisfaction, in so soldering the iridium and gold together, that he obtained a perfect pen, convenient and indestructible. 'I was now satisfied,' says Mr. Hawkins, 'that with fair usage I had a pen for my lifetime.' Thus begins the actual history of the gold pen as such. The progress of the manufacture has since been constant and rapid, both in England and America. We believe the first right

sold in Great Britain was to a manufacturer named Mordan, who is yet one of the largest dealers in the article in London. Mr. Levi Brown is generally acknowledged to have been the pioneer in this country; and other manufacturers have followed him in rapid succession, until there are now, in various parts of the Union, some twenty establishments. Of these, New York alone (city and State) contains at least a dozen.

“To render the subject clear and comprehensive, we will briefly trace the formation of a single gold pen through the different stages of its manufacture. 1. The gold is melted, in quantities ranging from a few to many ounces, as the requirements of the establishment may at the time demand. Victoria sovereigns are generally used in preference to all other qualities of gold; occasionally, however, fine jewelry is employed for the purpose. Usually, the value of one day's melting is from \$300 to \$400. This amount suffices the wants of the workmen for about a day and a half or two days. The metal is alloyed with silver and copper for twelve, fourteen, or sixteen carats. 2. The gold is rolled into strips, through a powerful machine, which thins and lengthens the ingot at each revolution. 3. The ‘blocks,’ or angular morsels of the gold, tapered toward one end, are cut by a separate workman and machine. 4. The tapered ends are filed, half through the thickness of the block. 5. In the niche thus formed, the iridium-point is set. This is a very delicate operation, requiring a good eye and an experienced workman. 6. The ‘diamond-point’ is secured by soldering together the iridium and the gold. A very small but intense heat is applied at the point, by the agency of a minute jet of flame. 7. The point is ground square. 8. The pen is rolled and hammered. 9. It is cut to the proper shape, in a small, neatly-contrived machine, in which works a steel die. 10. The pen is turned up perfectly semicircular, as it comes to the hand of the purchaser. 11. The point is split, having before been guarded from injury by small grooves in the different machines through which it has passed. 12. After the nib is thus started, another workman cuts the slit the necessary length. 13. The nibs are now cut accurately. 14. The points are set together, and the pens filed into shape. 15. They pass into the grinders' hands. 16. They are stoned and polished. 17. The nibs are finally adjusted, the point smoothed, and the pen is ready for writing. 18. Every pen is now tried with ink. If it be defective, it returns to the operatives; if not, but writes readily and smoothly, it is transferred to the office, placed in the holder, and exposed for sale.

“Such, briefly, are the various processes through which every pen is compelled to pass before it is ready for the hand of the purchaser. Iridium, which forms the so-called ‘diamond-point’ of the gold pen, is the hardest known mineral next to the diamond, and is the only one which at all answers the purposes required in the delicate manufacture of which we are speaking. The iridium used in this country is from the mines of Siberia, and from South America, and is obtained through agents in England, being purchased largely expressly for the use of the gold-pen manufacturers. Its price in gross bulk

ranges from \$30 to \$75 per ounce, no good qualities being procurable at a lower rate than \$30. Indeed, some years ago, very excellent samples are known to have commanded \$100 an ounce. The same quality, again, which was valued five years ago at \$15 and \$20 per ounce, now brings \$50. As the demand has increased, the quality of the mineral has also grown poorer; it being now quite difficult to procure good qualities to any large extent, the bulk of that imported being at least seven eighths waste. Two factories in this country turn out annually 104,000 gold pens, complete; or an average of 2,000 per week. To supply customers and the trade, 150,000 pen-cases, gold and silver, are also required annually. In addition to these, about 10,000 pencil-cases (without the pen) are called for; these establishments largely supplying the trade in all parts of the country, besides satisfying a very extensive retail demand. A large amount of iridium is of course consumed every year for the immense number of pens manufactured, each of which requires a selected 'point,' carefully chosen from the mass imported in bulk. Here occurs the great waste of this material, of which we have before spoken. We have understood that an average of two hundred ounces of iridium is used up every year for the gold-pen manufacture, in the different establishments of our own country."

IMPROVEMENT IN LITHOGRAPHY.

In *Jameson's Philosophical Journal*, for January, we find a description of an improved process in lithography, the invention of Messrs. Schenck and Ghemar, of Edinburgh. A grained lithographic stone is a little warmed, then the composition used for rubbing in tint-stones, known to the generality of lithographers, mixed with an addition of white wax and a little copal varnish, is rubbed down with a piece of coarse, short-haired flannel, or coarse cloth, until the color becomes an equal brown gray. After this the drawing is either sketched upon the stone with soft lithographic chalk, or traced in the ordinary way with red paper. The lighter parts may be rubbed lighter in color; the highest lights are taken out with a scraper, which is also used to blend the finer tints carefully together; darker paints can be rubbed in darker, and finished with softer or harder lithographic chalks. The darkest parts are laid in with liquid ink, with the brush or pen, after which the stone is strongly prepared with acid, and thus in a short time a very powerful design can be produced. Drawings executed in this manner are easily printed, and stand many impressions. The merit of this process consists in taking advantage of the chemical composition of the stone and the chemical nature of its printing, and the discoverers say that in numerous trials they have been able to produce "almost instantly the middle tints of any surface *and which do print*," — a result which in every other mode of printing requires much time. The cause of the reproach often made against lithography, of its gray tone and want of color, is thus removed, and it may now safely be averred that great power, depth, and brilliancy of tone, together with a variety of texture, can be attained with great

ease, and in from one tenth to one twentieth of the time required to do finished lithographs in the ordinary chalk method. The editor of the journal vouches for the value of this discovery, which has been already applied quite extensively.

NEW MODE OF STEREOTYPING.

PROF. C. C. JEWETT, in developing his plan for stereotyping the catalogues of libraries, referred to elsewhere, described to the American Association a new mode of stereotyping, which seems to possess many advantages. It is the invention of Mr. Josiah Warren, of Indiana. The material which he uses for stereotyping costs not more than three cents an octavo page. The process is so simple, that any man of average ingenuity could learn to practise it successfully by two or three days' instruction. The cost of apparatus for carrying on the work on a small scale, but in a workmanlike style, need not exceed \$10. The rapidity of execution is such, that one man could produce at least 25 octavo pages a day, all finished and ready for use. The plates will give a beautiful impression. They seem more durable than common stereotype plates; and, so far as now known or feared, they are not in any greater degree liable to injury. A company of practical printers have purchased the right to use this process in the District of Columbia, after having entirely satisfied themselves of its value; and they are now stereotyping by it a part of the Patent Office Report. This invention was patented several years ago. But very important improvements have lately been made by the patentee, which have brought it to a high degree of perfection. We understand that the material used is a kind of clay, very abundant in the Western States, which is mixed with oil. We have seen a plate made by this process from which 40,000 impressions had been taken, and yet practical printers declared themselves unable to detect any wear or depreciation. — *Editors.*

BANK OF ENGLAND NOTE.

AT the meeting of the Royal Institution on Feb. 15, Rev. J. Barlow read an interesting paper on the "Characteristics of a Bank of England Note," from which we abridge the following. The paper is distinguished, — 1. By its color, a peculiar white, such as is neither sold in the shops nor used for any other purpose. 2. By its thinness and transparency, qualities which prevent any of the printed part of the note being washed out by turpentine or removed by the knife, unless a hole is made in the place thus practised on. 3. By its characteristic feel, a peculiar crispness and toughness, by which those accustomed to handle it distinguish the true notes instantly. 4. The wire or water mark, which is produced on the paper when in the state of pulp, and which is easily distinguished from a mark stamped on after the paper is completed. 5. The three *deckle* edges. The mould contains two notes placed lengthways, which are separated by a knife at a future stage of the process. The *deckle* (or wooden frame of the

paper mould) produces the peculiar effect seen on the edges of uncut paper. Being caused when the paper is in the state of pulp, it cannot be successfully imitated after the paper is made. 6. The strength of the paper, which is made, not from the worn fibre of old garments, but from new linen and cotton. In its "water-leaf" or unsized condition a bank-note will support thirty-six pounds, and when one grain of size has been diffused through it, it will lift half a hundred-weight.

The printing processes are briefly as follows. The bulk of the note is printed from a steel plate, the identity of which is secured by the process of transferring. The paper is moistened for printing, by water driven through its pores, under the pressure of the atmosphere admitted into the exhausted receiver of an air-pump, and 30,000 double notes are thus moistened at the bank in an hour. The ink used in plate-printing is made at the bank, from linseed oil and the charred husks and vines of Rhenish grapes. This so-called Frankfort black affords a characteristic velvety black, very distinguishable in the left-hand corner of the note. The D cam perfects every impression when once drawn through the press. The numbering and cipher printing are also executed in one of the presses in the use of the bank. Several of the processes have been omitted, as not intelligible without drawings.

PRINTERS' INK.

An application for the composition of a printing ink has been admitted to be the proper subject of letters patent, but they could not be issued till after the close of the year; still, as the invention is regarded as an important one, some account of it is deemed proper in this place. Linseed oil and lampblack are the well-known ingredients of printers' ink, and the preparation is necessarily attended with a tedious, disagreeable, and dangerous process of boiling and burning, in order to give the ink the peculiar tenacity required. The invention here set forth consists in the introduction of a new oil, not before used for such purposes, and thus modifying the process, so as to obtain an ink of superior quality, without the dangerous process of burning. Considering the large amount of this material used at the present day, and the comparative cost of the two oils (the expense of the linseed being four times that of the rosin oil), this invention assumes an importance in the improvements of the day not usually met with. It is also stated that the introduction of this oil enables the printer to print with delicate and fancy colors, which cannot be done with ink manufactured from linseed oil. The oil here referred to, and called *rosin oil*, is obtained by the destructive distillation of common rosin. — *Patent Office Report*, 1849.

NEW METHOD OF GILDING PORCELAIN.

M. GRENON has submitted to the Society for the Encouragement of National Industry, at Paris, an improvement in gilding porcelain, which adds much to its durability. The operation of gilding, as gen-

erally practised, consists in mixing with the preparation of gold and protonitrate of mercury, a certain quantity of subnitrate of bismuth, which serves as a flux, and allows the metal to be burnt into the porcelain. M. Grenon's process, however, consists in the successive application of two layers of gold, each having a special flux, and in different proportions. The first layer is burnt in at a high temperature, after which it is polished with rotten-stone, and on it is laid a thin coating of mercury-gold, which is prepared and burnt in the ordinary manner. This gilding is easily burnished, takes a fine polish, and is not injured by friction from hard bodies. — *London Mining Journal*, May 4.

NEW PROCESS FOR ORNAMENTING GLASS.

A FEW years since a discovery was announced by which a deposit of silver from its solution in nitric acid was made, by the action of the essential oils of cassia and cloves. Unfortunately, however, time has proved that the silver thus deposited on glass in a few months becomes reconverted to a salt, covering the glass with dirty brown spots. But a new process has just been introduced by Mr. Kidd, of Poland Street, in which, by the application of an amalgam of mercury and platinum, a mechanical deposit is effected, so that the discoverer has been able to represent every description of fruits and flowers, by engraving them on the under side of the glass. When silvered, they appear as if in relief, or raised on the outside surface. So accurate is the process of engraving, by a number of minute needles in the lathe, that any lace-pattern or embroidery may be represented with the utmost precision. — *London Mining Journal*, April 13.

NEW MINERAL PAINT.

WITHIN a comparatively recent period, Mr. John L. Skinner, of Springfield, Mass., has succeeded in manufacturing from a peculiar soft shale, belonging to the sandstone deposits of the Connecticut valley, a valuable mineral paint, which is fully equal, if not superior, to the celebrated mineral paint found near Akron, Ohio.* It is of different shades of slate, freestone, drab, and umber, and where those shades are desired is particularly valuable, as it not only has all the body and beauty of lead paint, but surpasses it in durability. Its chief excellence consists, however, in its power to resist the action of fire and water. After being applied and exposed to the air, it becomes gradually indurated, so as to present in time a perfect slate surface. The coating of paint when dry is susceptible of a very high polish, and has been used with great success on carriages and like work. For dark surfaces, this paint will, we think, be superior to any other material now in use. The application of the material as a pigment is new, and in a scientific point of view exceedingly interesting. Specimens of wood painted with this mineral, of a fine polish, were exhibited at

* See *Annual of Scientific Discovery*, 1850, p. 93.

the last meeting of the American Association, and could not be distinguished from some metallic painting exhibited at the same time by the Zinc White Company of New Jersey. The following is an analysis of this shale, made by Dr. C. T. Jackson:—

Water, 8.5; silica, 51.3; alumina, 16.0; peroxide of iron, 20.0; carbonate of lime, 2.8; magnesia with traces of manganese, 1.0.—*Editors.*

TRANSPARENT CEMENT.

At the meeting of the Franklin Institute, on Sept. 19, an excellent transparent substance, well adapted to replace Jeffries's marine glue, for many purposes, particularly where a transparent joint is required, as in the union of pieces of glass, invented by Mr. S. Lenher, was exhibited, and its properties explained. Small glass boxes, for containing microscopic objects, united by it, were shown. The composition of the cement is, caoutchouc fifteen grains, chloroform two ounces, mastic half an ounce. The two first-named ingredients are to be first mixed; after the gum is dissolved, the mastic is added, and the whole allowed to macerate for a week, which is about the time required for the solution of the mastic in the cold. More of the caoutchouc may be applied where great elasticity is desirable. The convenience of its application with a brush, cold, recommends it for approval.

METHOD OF HARDENING OBJECTS IN PLASTER OF PARIS.

TAKE two parts of stearine, two parts of Venetian soap, one part of pearlash, and twenty-four to thirty parts of a solution of caustic potash. The stearine and the soap are cut into slices, mixed with the cold lye and boiled for about half an hour, being constantly stirred. Whenever the mass rises, a little cold lye is added. The pearlash, previously moistened with a little rain-water, is then added, and the whole boiled for a few minutes. The mass is then stirred until cold, when it is mixed with so much cold lye that it becomes perfectly liquid, and runs off the spoon without coagulating and contracting. Before using this composition, it should be kept for several days well covered. It may be preserved for years. Before applying it to the objects, they should be well dusted, the stains scraped away, and then coated by means of a thick brush with the wash, as long as the plaster of Paris absorbs it, and left to dry. The coating is then dusted with leather or a soft brush. If the surface has not become shining, the operation must be repeated.—*Chemical Gazette.*

BRONZING PLASTER-CASTS.

M. ELSNER states in the *Comptes Rendus* that a brownish-green bronze for plaster figures may be very easily obtained by adding to a solution in water of palm-oil soap, a mixture of sulphate of iron and sulphate of copper in solution; this furnishes a brownish-green precipitate, the color of which may be modified at pleasure by the addi-

tion of a greater or less quantity of one or the other of these salts. The precipitate, after being washed and dried, is redissolved in a siccativ essence, or a mixture of good varnish of linseed oil and wax ; and with this solution the figures (having been previously heated) are coated ; on drying, they will be found to possess the color mentioned above. Perhaps a better result is obtained by employing a solution of the salt of iron only, instead of the mixed solution of the sulphates.

PATENT FOR A DAGUERRETYPE CASE.

AN invention of a lady, consisting of a conical glass case, blackened on the upper half of its inner surface, and ground on its lower half to admit the light necessary for viewing the picture, which is secured in the larger end of the case, the smaller end being provided with a magnifying lens, through which the picture is to be examined. In the ordinary examination of these pictures, every one must have observed the difficulty of getting a proper light. The specular reflection of the plate interferes with the view, and it is necessary to admit the light to the plate laterally, and hold over it some dark or absorbing surfaces. Persons wearing dark dresses can generally obtain a good position, without much trouble. This inconvenience is obviated by the invention, and as the picture will bear magnifying with advantage, the lens comes in opportunely for this purpose, as well as that of closing entirely the glass case, and preserving the picture from dust and exposure to the air. — *Patent Office Report*, 1849.

IMPROVEMENTS IN THE MANUFACTURE OF STARCH.

A PATENT has been granted during the year, in England, for improvements in effecting the separation of starch from other substances with which it is combined in farinaceous and leguminous materials, by a more expeditious process, and by the use of cheaper agents, than are commonly employed. The substance of the specification is as follows : — We take whole or broken grains of rice, with or without the husk, or rice flour, and place in a shallow, or other convenient vessel. We then pour in a solution of lime and common salt, sufficient to cover the whole of the rice, about 26 gallons of the solution to about 112 pounds of rice. The solution is made by mixing slacked lime, salt, and water, in the proportion of about 100 pounds of lime and 30 of salt to 500 gallons of water. The solution is allowed to settle, and the clear liquor only made use of. We let the rice remain thus submerged for six hours, stirring it well every half-hour. The liquor is then drawn off by suitable taps, and a fresh solution added, which, after standing six hours, is also drawn off. The rice is then ready to be ground, which is effected in the ordinary way. The ground rice is then transferred to a suitable vessel, covered with a similar solution, and well stirred for two or three hours. From this vessel the rice is removed to a separating vessel, where it is left to stand for six hours. In this time the starch separates from the gluten and falls to the bottom of the vessel, while the gluten floats upon the top liquor. The

liquor and the gluten being drawn off, and the residue washed with water, we have a pure starch mixed with fibrine; this latter is separated from the starch in the usual way adopted by the rice-starch makers. The gain by the use of the lime and salt solution is such, that we can advance the manufacture of starch in about 48 hours to the same stage which it now requires 132 hours and upwards to arrive at, and obtain besides an increase of from six to seven per cent. in the quantity produced. The starch is also purer than any obtained by means of a caustic alkaline or acid solution, and is fitted for all purposes to which wheat-starch, produced by fermentation, is usually applied. Starch of a good quality for some purposes, though not for all, may also be made by using solutions of lime alone, in the manner before specified. The solution of lime and salt may be employed with like good effect in manufacturing starch from rye, peas, beans, and other leguminous substances, and in the preparatory steps also of the manufacture of other like articles of commerce, such as dextrine or British gum. — *For detailed account see Chemist, May, 1850.*

IMPROVEMENT IN THE PREPARATION OF FLAX.

THE *London Morning Chronicle*, for Nov. 15, notices an improvement in the manufacture of flax, recently patented by M. Claussen. Hitherto a great obstacle in the way of the successful cultivation of flax has been the trouble, delay, and expense attendant upon its steeping, in order to prepare it for the market; but the new invention entirely supersedes the process of steeping, and the fibre is handed over to the spinner in a perfectly natural and unimpaired condition, free from dirt and discoloration, and retaining all those oleaginous properties on which its strength so much depends. The inventor has also discovered a means of obviating the *cold feel* which has always been deemed an inherent characteristic of linen fabrics. He has succeeded in manufacturing the unsteeped flax into various descriptions of material, possessing respectively all the warmth of wool, the softness of cotton, and the glossiness of silk, and closely resembling these fabrics both to the eye and the touch. The cost of converting the unsteeped flax into "cotton" amounts to no more than seven sixteenths of a penny per pound, and the difference between the price of flax thus prepared and that of raw cotton is estimated at from one third to one half in favor of the former.

The *Chronicle* further says: — "We stated on Monday that there had been placed in our hands a quantity of flax rovings and yarns spun upon cotton machinery by the inventor. Since that period we have had an opportunity of personally inspecting at Manchester the whole process connected with the invention, and the result has fully convinced us of its practicability. The finest portion of the yarn spun was equal in fineness to 120's cotton, the coarsest being equal to 60's. The application of such a test as that of 120's for the first time was certainly a most severe one; the result, however, was perfectly successful. A slight difficulty arose at first with the machinery, in consequence of the length of the fibre; this, however, was easily obvi-

ated by a slight alteration in the position of one of the rollers. As the fibre may be prepared to any length, there will be no necessity in future for even this alteration, the existing cotton machinery being perfectly adapted for the purpose of spinning flax prepared according to the process patented by M. Claussen. The patent granted is for the preparation of flax in a short staple, so as to produce a substitute for wool and cotton capable of being spun upon cotton machinery, and also for the mixture of the materials thus obtained, which can be carded together with silk, cotton, or wool, or separately. The right is also secured for preparing long fibre as a substitute for silk, for bleaching, in the preparation of materials for spinning and felting, and also in yarns and felts. The inventor does not, however, confine himself to flax for the purpose of producing a fibre adapted to his purpose, but states that he can obtain similar results from hemp, jute, Chinese grass, and, to use his own expression, 'from an old tar rope, or a bamboo cane.' In consideration of the importance attached to this subject, the Board of Trade have consented to relax a general principle, and to grant a charter to a company who propose to bring into flax cultivation no less than 100,000 acres, and to purchase the produce at the rate of £12 per acre. The whole of the new process, from the first preparation of the raw material to the final manufacture of the "cotton," "silk," and "wool" into textile fabrics, will be shown at the Exhibition of 1851.

IMPROVEMENT IN DISTILLING MERCURY.

M. VIOLETTE has described to the French Academy an improved mode of distilling mercury, by means of the vapor of water brought to an intense heat. The process consists in plunging the amalgam into a current of vapor of water heated to 350 or 400 degrees Centigrade. The aqueous vapor acts at the same time as a calorific agent and as a mechanical agent. It heats the metal to the temperature required for its vaporization, and then bears off with it the metallic vapors, leaving free space for continued distillation. The mingled vapors of water and mercury are condensed in an ordinary refrigerator. The water and metal are precipitated separately to the bottom: and two small distinct streams are observed issuing from the refrigerator, one of mercury below, that of water flowing on the top. The loss and waste by this method are represented to be absolutely nothing, or so small as to be unworthy of notice. Such, at least, has been the result of numerous experiments, made with the pure mercury, with amalgams of tin, silver, and gold, with goldsmith's ashes, and with metals gilded and plated. In operating upon an amalgam obtained from the mines of Brittany, it was remarked with special satisfaction that the mercury did not bear along with it to the refrigerator an atom of the metals dissolved by it. This total exemption is never observed in the distillation of mercury by the ordinary process. It is averred that the cost of distillation by the method of M. Violette will be actually less, apart from the economy effected by avoiding waste, than that of distillation by the ordinary process. The grand

results said to be secured are cheapness of distillation, perfection in the operation, saving annually for France alone an amount of the metal estimated at two hundred and forty thousand pounds; and, lastly,—and this is the most important consideration,—the rendering *absolutely innocuous* an occupation which proves inevitably and speedily fatal to all who continue steadily employed in it. The distillation of mercury is henceforth as harmless as the distillation of water. — *Paris Correspondent of National Intelligencer.*

IMPROVEMENT IN THE MANUFACTURE OF WHITE-LEAD.

THE *London Mechanics' Magazine* says, that Mr. J. E. D. Rogers has recently taken out a patent for an improved method of manufacturing white-lead. He proposes to manufacture it by suspending pieces of sheet or cast lead, bent in the form of two sides of a triangle, upon frames erected in a room or chamber which is capable of being darkened and rendered air-tight, or nearly so, when required. Underneath the frames are troughs, some of which are filled with a fluid capable of passing into the state of vinous fermentation spontaneously, or of doing so on the addition of yeast, and thereby evolving carbonic acid gas. The other troughs contain sour beer, vinegar, or other similar fluids, into which steam-pipes from a boiler are caused to open, so as to produce acetic acid, or pyroligneous acid and aqueous vapors. The *modus operandi* is as follows:—The pieces of lead are suspended in the frames, as close together as possible, without actual contact, and the chambers made air-tight, and maintained at a temperature of from 70° to 80° F. As soon as the carbonic acid gas is evolved, the chamber is darkened, and steam admitted about three times in every twenty-four hours. The chamber is provided with a man-hole, to allow of the troughs being replenished when the fluid contents have been exhausted, which will occur at the expiration of forty-eight hours. This operation for converting metallic lead into carbonate of lead generally takes twelve days.

AMERICAN SALT.

From the report of a committee to the New York Legislature, April, 1850, we derive the following facts.

About one third part of all the salt manufactured in the United States is made at the Onondaga salt springs, and nearly one fourth of what is consumed in the Union comes from the same source. Under the fostering care of the State, the quantity manufactured has constantly increased from year to year, until, as stated by the superintendent, the number of bushels in 1849 exceeded five millions, requiring the daily consumption of one thousand cords of wood, and the daily use of eight thousand barrels during the manufacturing season, and furnishing employment in the various departments connected with the interest of more than five thousand men. For a series of years the State derived considerable revenue by tax upon the whole amount of salt manufactured; but of late this policy has been to a great extent

abandoned, and the revenue derived from that source now amounts to comparatively a small sum. By the removal of the tax, the domestic salt became just so much cheapened to the consumer, and by a reference to the statistics of the prices current of salt in the city of New York for the last few years, it will be seen that the domestic article has had its influence in reducing the price of the foreign from 50 cents, in 1832, to 24 cents per bushel in 1849. To evaporate the brine of five million bushels of salt, the quantity made in 1849-50, would require 125,000 cords of wood, which at \$2.50 would cost \$312,500. One million of barrels are required for packing, which, at

25 cents each, is	250,000
The laborers' wages for boiling 5,000,000 bushels, at \$1.75 per hundred, are	87,500
The State duty of one cent per bushel is	50,000
Packing, half a cent per bushel,	25,000
	<u>\$725,000</u>

One million barrels of salt at 75 cents per barrel, this being the average price of the season, is \$750,000

Thus it appears from a receipt of three fourths of a million of dollars' sales for the year, that the farmers for the wood, the coopers for the barrels, the laborers for boiling and packing, and the State for the duty, are paid \$725,000, leaving but \$25,000 per annum as the product of the salines, out of which is to be paid the expense of kettles, buildings, &c. The profit on solar evaporated salt the committee state to be somewhat greater than the above calculations show to be derived from boiled salt.

If, in addition to the quantity of salt manufactured at the salines and on the sea-shore of the United States, we add the quantity of salt imported, the aggregate will nearly equal twenty-two million bushels, which is equal to an apportionment of one bushel to every man, woman, and child in the country. The committee also recommend that in the curing of butter none but solar evaporated salt be used, butter dealers making a difference of from one to two cents per pound in the price of butter salted with the two kinds of salt.

Solar salt is also considered preferable for curing meats for long sea voyages, and for exportation to tropical climes. Provisions cured with boiled salt are not accepted by the government for the use of either the army or navy. The reason for this preference of solar evaporated salt over boiled salt arises from the fact that the latter, from the process of manufacture, cannot be so pure as the former; and besides, it would not be preferred by packers, for the reason that coarse salt keeps the meat from settling close together in the barrel, and the salt remaining undissolved between the pieces or layers of meat thus furnishes continually a supply of its preservative qualities to the pickle.

MANUFACTURE OF BEET-ROOT SUGAR IN EUROPE.

DR. STOLLE, of Berlin, has published a beet-sugar map of Europe, in which nothing is marked down except the boundaries and names

of states, the courses of rivers, and the sites of the manufactories of beet sugar. It appears that there are in Russia, 430 factories; in France, 288; in Prussia, 114; in Austria, 114; in the rest of Germany, 30; in Belgium, 27; in Poland, 21; making in all 1,024 factories. These facts may give an idea of the vast extent of the sugar industry in Europe. Since the discovery by the Prussian naturalist, Markgraf, of the mode of extracting sugar from beets and potatoes, it has been an object of the policy of the different European states to protect this industry by high duties. Though the article produced is insipid in comparison with the cane-sugar, the price is exorbitant. In France, for instance, the price of common sugar, such as that used by ladies for preserving fruits, is sixteen sous a pound, that of table sugar twenty, and that of the better sorts between twenty-five and thirty. In Prussia the prices are lower, but the sugar is not so good, being in great part manufactured from potatoes. It costs from ten to fifteen cents a pound, but, as a sweetener, is equivalent to only half the quantity of cane-sugar. Several attempts have been made to manufacture beet-sugar in the United States; they have all proved failures. Future attempts of a similar kind must also fail; for the beet-sugar is nowhere made for less than eight or ten cents, even in Europe where labor is so cheap, and cannot compete with the product from the cane.

Beet-Sugar in France.—The following statistics exhibit the produce and consumption of beet-root sugar in France, from Jan. 1 to Sept. 1, 1850:—Number of manufactories in full operation, 288; kilogrammes of sugar produced, 62,175,213, or 23,000,000 more than last year. Sugar in bond and sold for consumption, 64,644,594 kilogrammes.

MEAT-BISCUIT.

A LETTER from Dr. Ashbel Smith was read to the American Association, at Charleston, giving an account of a newly invented preparation, called "meat-biscuit." The inventor, Mr. Borden, "claims, as you will see, to have discovered a process for combining, in a cheap, convenient, and portable form, all the nutritive portions of animal and farinaceous food. His invention has the further advantages, that all refuse, excrementitious, and superfluous matters are rejected; and it can be preserved *fresh*, without condiments or preservatives of any kind, for years, and in all climates,—care only being taken that it be kept dry. From several satisfactory trials, it is proved that Mr. Borden's process is equally adapted for combining any farina, any flour or meal, with any of the meats of the animal kingdom used by man for food; but he has hitherto confined himself to combining wheat-flour with the flesh of neat cattle. I will briefly allude to the manner of preparing the biscuit. The nutritive portions of the beef, or other meat, immediately on its being slaughtered, are, by long boiling, separated from the bones and fibrous and cartilaginous matters. The water holding the nutritious matters in solution is evaporated to a considerable degree of spicitude; this is then made into a dough with firm

wheat-flour, the dough rolled and cut into the form of biscuits, and then desiccated, or baked, in an oven at a moderate heat. The cooking, both of the flour and the animal food, is thus complete. The meat-biscuits thus prepared have the appearance and firmness of the nicest crackers or navy-bread, being as dry, and breaking or pulverizing as readily as the most carefully made table-crackers. It is preserved in the form of biscuit, or reduced to a coarse flour or meal. It is best kept in tin cases hermetically soldered up; the exclusion of air is not important, as humidity alone is to be guarded against. I have seen some of the biscuit perfectly fresh and sound that have been hanging in sacks since last July in Mr. Borden's kitchen; and it is to be borne in mind, that in this climate articles contract moisture and moulder promptly, unless kept dry by artificial heat.

"For making soup of the meat-biscuit, a batter is first made of the pulverized biscuit and cold water; this is stirred into boiling water; the boiling is continued some ten or twenty minutes; salt, pepper, and other condiments are added to suit the taste, and the soup is ready for the table. I have eaten the soup several times; it has the fresh, *lively, clean*, and thoroughly-done or cooked flavor that used to form the charm of the soups of the *Rocher de Cancale*. It is perfectly free from that vapid, unctuous, stale taste which characterizes all prepared soups I have hitherto tried at sea and elsewhere. Those chemical changes in food which, in common language, we denominate cooking, have been perfectly effected in Mr. Borden's biscuit by the long-continued boiling at first, and the subsequent baking or roasting. The soup prepared of it is thus ready to be absorbed into the system without loss, and without tedious digestion in the alimentary canal, and is in the highest degree nutritious and invigorating. It is to be noted, moreover, that the meat-biscuit is manufactured without salt, pepper, or any condiment or chemical antiseptic whatever. We have thus an article of food, partly farinaceous and partly animal, such as the system requires for long-continued use; it is easily preserved, in all climates, seasons, and circumstances, is in a form the most concentrated and convenient, is prepared easily and quickly, and is, moreover, cheap."

IMPROVEMENTS IN THE PRODUCTION OF LIGHT AND HEAT.

AN English patent was granted, May 22, to M. Gillard, of Paris, for certain improvements in the production of heat and light. The invention, according to the specification, consists in certain apparatus and processes for producing hydrogen gas, by the decomposition of water, and its application to heat and light. The means by which the gas is obtained are:—1. by the incandescence of iron; 2. by carbon; 3. by magnets. *First, the means of obtaining hydrogen by decomposing water by heated iron.* Into retorts fitted for the purpose with iron tubes, chains, wire, or spirals of the same metal rendered incandescent, the patentee introduces steam supplied from any source, or even produced by means of water injected into the retorts. The oxygen of the water combines with the iron, and the hydrogen is conducted into a refrigerant, and then into a gasometer for use. When the iron is

oxidized, the patentee deoxidizes it, first by means of the waste gas of furnaces; the carbonic acid of the furnaces is at first changed into oxide of carbon, within the furnace in which the hydrogen as well as the oxide of carbon is produced; the last gas is obtained by the passage of steam into the oxide furnace (a kind of kiln); the oxide of carbon and hydrogen are afterwards injected into the retorts containing the oxidized iron; this latter transmits the oxygen to the oxide of carbon, and to the hydrogen, which has been generated in the furnace for oxide of carbon. Secondly, the iron may be deoxidized by causing pulverized coal to fall on hot iron; also by igniting with oxide of iron some hydrogen, or oxide of carbon, or by throwing upon the hot iron some oil, or any of the hydro-carbons.

Secondly, the process for obtaining hydrogen by the decomposition of water with incandescent coal, or by means of oxide of carbon. The patentee causes steam to pass into horizontal retorts similar to those employed in gas-works, filled up more or less with deep layers of coal; the steam is distributed to the whole of the retorts and over the surface of the coals by means of one or more pipes in connection with a boiler, pierced with holes of a small diameter, like the spout of a water-pot; the contact of the steam produces hydrogen, carbonic acid, and a small quantity of oxide of carbon and other gases; these mixed gases pass off through the educt pipe into an epurator, when the carbonic acid is taken up, and the hydrogen passes off into the gasometer. The patentee observes that this apparatus for decomposing water is similar to that in which coal is distilled, differing, however, from it as regards the steam-tubes, the boiler, and the system of depositing the steam on the surface of the coals, instead of passing it through them; these points the patentee states to be new. The patentee also decomposes water by means of magnets, working with induct bobbins; the movement of each magnet on an axis sets in motion all the bobbins, and as there is only one resistance of attractive action which is resisted by that of the opposite pole, it follows (states the patentee) that in communicating such force I put in action a considerable number of magnets, by means of cogs, and transmission of mechanical movements, and the magnets decompose the water; pure hydrogen may be collected at one pole, and pure oxygen at the other, and stored in separate gasometers for use.

The patentee's improved process for rendering hydrogen gas illuminating, is by causing a small jet of lighted hydrogen to pass through a burner (the holes very small) on a thin strip of platinum, or a wick of platinum wire, the threads being excessively fine, and of a graduated action, proportioned to the intensity of the pressure of the flame and the burning hydrogen; a very powerful light is thus produced. The platinum threads are immediately heated to such a whiteness that the luminous refulgence is extraordinarily brilliant. Besides platinum, other unalterable and unoxidizable metals may be employed. The wick must be of the shape necessary to agree with that of the jet of hydrogen. It may be that of a cone or any other figure, according to the size which the gas takes when it is allowed egress from the burner; the wick must be made more or less strong, according to the

greater or less intensity of the heat to which it is exposed. — *London Patent Journal*.

The *London Times* describes an exhibition given at Vauxhall Gardens, with a view of testing the discoveries of M. Gillard. It says, — "The process for the manufacture of the gas consists in the decomposition of water by passing a jet of steam over a bed of incandescent charcoal in a retort, the gaseous products of which are hydrogen and carbonic acid gas. The latter being separated by the action of quicklime in a purifier, the hydrogen in a state of comparative purity is inducted to a gas-holder for use. Pure hydrogen, however, possesses but little illuminating power, burning with an unsteady flame, and emitting great heat. To remedy this, M. Gillard has invented an apparatus of platinum wire, which is fitted by a brass frame to the burner, by which the flame is converted into a column of intensely white light, and, by the application of a brass chimney, a steady light is produced without the emission of a particular smell or smoke. The experiments were made at Vauxhall under disadvantageous circumstances, but they were completely successful. The works, which had not been used for years, were out of order, but after a time they were brought into action, and a clear, powerful, and pure light was produced. It was stated that the hydrogen could be manufactured for 4*d*. the thousand feet, and that the cost of the platinum would make but a very inconsiderable addition to the charge."

GAS FROM WATER.

THE *New York Post* says that a means of procuring gas for illumination from water has been recently applied in that city. The proprietors of the Astor House have been using this gas for the last four months. The light, they inform us, is much superior to that obtained from the common gas, with which the whole city is supplied, while the expense is less than one half. The apparatus, which is set up in a small building at the rear of the hotel, is very simple in its construction, requiring only the attendance of two men, who, in seven hours, can turn off sufficient gas for twenty-four hours' consumption. The following is, as near as we could ascertain, the process by which the gas is produced. The water used in its manufacture is discharged from a can, in limited quantities, into a pipe passing through the retort. This retort is kept constantly supplied with iron and charcoal, the intense heat from which converts the water, in its passage through the pipe, into steam. The steam thus formed is amalgamated with liquid rosin, of which there is always a large supply kept in a boiler placed immediately over the retort, so that the gas is obtained simply from the combination of steam generated in the manner described, and the liquid rosin. The volatile oil produced during the manufacturing process is discharged through a separate pipe into receiving vessels. This oil is disposed of at half a dollar per barrel.

A company for the manufacture of this gas (which, we believe, is that used in the Clipper office in Baltimore, and known as Brown's), has been formed in Jersey City, with a capital of \$500,000. They

purchased the patent-right, which has since been sold at auction to different persons, and the whole produced about \$520,000, showing conclusively that confidence is felt in the value of this discovery.

NEW MATERIAL FOR THE MANUFACTURE OF GAS.

EXPERIMENTS have been recently made by Dr. Gesner, of Nova Scotia, under the auspices of the Earl of Dundonald, with a view of testing the applicability of the asphaltum furnished by the great pitch lake of Trinidad, as a material for the manufacture of gas. In the dry distillation of this substance, large quantities of carburetted hydrogen, similar to that employed for lighting, are produced. Some difficulties have, however, hitherto prevented the application of the gas, produced from this source, to the purposes of illumination. These difficulties Dr. Gesner professes to have so far overcome as to be able to manufacture a gas from asphaltum, much cheaper than from coal, rosin, or any other hydro-carbon. In a communication to the Academy of Natural Science he says:—"It is remarkable that so rich a hydro-carbon as asphaltum should have been so long overlooked, in reference to its capabilities for affording light. It had been tried for fuel, pavements, and for other purposes, both in Europe and the United States, but without success. For what purpose nature had formed such vast quantities of bituminous matter, which still continue to flow from the earth, was a problem not readily solved, until this discovery, which brings it into operation for illuminating purposes, to which it is admirably adapted. In the analysis given by the chemists of Europe of the bitumen of Trinidad, there is a great diversity. Some have stated that it contains twenty and even thirty per cent. of silex, when in fact it seldom contains ten per cent. The specimens submitted to their investigations must have been taken from the beach forming the great pitch lagoon of the island, where the sand of the shore is frequently mixed with the bitumen. The following table gives the comparative quantities of volatile matter and carbon existing in coal and bitumen:—

	Volatile Matter.	Coke, or Carbon.
Bitumen of Trinidad, . . .	65.50	36.57
“ Barbadoes, . . .	61.60	36.90
“ Cuba, . . .	63.00	34.97
“ Yucatan, . . .	62.60	35.20
Coal, best Cannel, . . .	44.00	52.60
“ Liverpool, . . .	40.48	54.90

For the production of gas, the advantages which bitumen possesses over coal are numerous. Sulphur not being one of its constituents, injurious and noxious gases are not produced in its decomposition, and the absence of nitrogen prevents the formation of ammonia. The ordinary time for the escape of the gas from a retort filled with coal is eight hours. During that period the retort must be kept at a bright red heat, and labor and fuel are in constant requisition. The gas from the same quantity of bitumen would be fully discharged in two hours, whereby a saving of three quarters would be effected in fuel

and labor, by its use instead of coal. As the bitumen also yields double the quantity of gas, there is a saving of one half in the labor of handling the material. The chief part of all the gas consumed in Great Britain and the United States is obtained from common bituminous coal, the average product of six varieties of which is 2.70 cubic feet from the pound, with a specific gravity of 0.529. The illuminating power of these gases is proportional to their specific gravity. Bitumen of the poorest quality gives five cubic feet to the pound, with a specific gravity of 0.720. Therefore the illuminating power of the gas from a pound of bitumen is to that obtained from a pound of coal (Liverpool) as 6.25 to 2.70. The cost of the material (coal) that now supplies gas for New York must be estimated at \$1 for every 1,000 cubic feet of gas. The bitumen may be abundantly supplied for \$5 per ton. The cost of bitumen, therefore, to supply 1,000 cubic feet of gas, would be only \$0.38. At a moderate calculation, by substituting bitumen for coal, the gas may be supplied to the consumer at less than one half of its present cost, and the manufacturer still make a profit.

The inquiry at once presents itself, what are the resources of bitumen or asphaltum? In reply, it may be stated that the lake of bitumen of Trinidad is altogether inexhaustible, and might furnish supplies for the whole world. Besides the abundance of this mineral along the whole coast of South America, Mexico, and Texas, it abounds in the island of Cuba, where a single stratum, six miles from Havana, is no less than 144 feet in perpendicular thickness. Thus far the employment of this substance, so astonishingly abundant, has not even been engaged in or undertaken for a practical purpose.—*Scientific American*, Feb. 16.

PURIFICATION OF COAL-GAS.

At the meeting of the Society of Arts, on April 24, Mr. Laming read a paper on the above subject. After some preliminary observations, the author described his new process, which has been successfully tried at the Westminster Works with 7,000 cubic feet of gas per hour, and is now being used with purifiers ten feet square. The purifying material, through which the impure gas is first passed, withdraws from it 17 parts of ammonia, 17 sulphuretted hydrogen, and 22 carbonic acid. It consists of a saturated solution of muriate of iron, decomposed by chalk or lime into muriate of lime and hydrated protoxide or carbonate of iron, and then mixed with breeze or sawdust, to absorb it. During the mixing the iron becomes highly peroxidized by the atmosphere. After a time the purifying material seems to be exhausted and ceases to act; but if we pass through it a current of atmospheric air, it becomes revived and acts as well as before. This process of revivification takes but an hour or two, and it has been repeated fifteen times; but a period will arrive when the material must be well washed to get rid of the ammoniacal salts formed, when it will be restored to its pristine condition. The advantages obtained by this process are, that the gas is completely purified with an increase in

illuminating power of fully eight per cent. ; the materials are inexpensive, may be repeatedly used, and give no unpleasant odor ; the impurities are disinfected and converted into marketable products of great value ; less resistance is opposed to the passage of the gas than by lime, and the quantity of gas from a given weight of coal is considerably increased. — *London Mining Journal*, April 27.

NEW PROCESS FOR TANNING.

A PATENT has been recently granted for an improved process of tanning, of which the following is a description. The hides or skins during the process of tanning are submitted to electric or galvanic agency, by placing a plate of lead and a plate of zinc on opposite sides of the pit, and connecting them by a metal strap above the level of the water. The skins are suspended in the pit for a week, in water, which is gradually converted into ooze, or tanning liquor, of the strength of 15° saccharometer, by the addition of bark ; or the water is removed and ooze substituted for it. The strength of the ooze is successively increased 5° every week, until it attains 45°, when the tanning operation is completed. — *London Chemist*, January.

NEW PROCESS FOR THE PRESERVATION OF TIMBER.

MAJOR HAGNER, in his report to the United States Ordnance Board of observations made during a recent military tour in Europe, gives the following account of Dr. Boucherie's process of impregnating timber with a solution of sulphate of copper. He confines the application, generally, to soft woods, and exhibited, among other articles, a work-box and secretary made of a tree within three months after it was cut, which proves the wood to be well seasoned. The color given by the sulphate of copper is quite pretty and peculiar, being in reddish and brown streaks and shades, not unlike the effect of painting. After varnishing, the appearance is rich, and is said to be permanent. Dr. B. shows a pine block sawed into three sections, but not disconnected, which has been buried in a fungus pit for six years. The two side sections were impregnated by means of the natural action of the sap vessels, the one with bichloride of mercury (corrosive sublimate) as recommended by Kyan, 800 grammes of 1.5 per cent. strength ; the other with 800 grammes of sulphate of copper, of 1.5 per cent. The centre section was left in its natural state. This last portion, and that impregnated with the bichloride, are equally and completely rotten, the fibre destroyed, and the wood crumbling into dust, while the section impregnated with the copper is perfectly sound and good. Sleepers on railways impregnated with copper have been in use six years and are still sound. The price for such sleepers is from ten to twelve francs per metre cube. The process of impregnation is conducted in the woods ; the logs are laid side by side, the large ends cut square by a saw, and arranged on the boundary lines of a square, inclining from but to branches. A trough communicating with the reservoir is carried all round the square, above the

butts, and small tubes run from this to each butt, and, in long trees, to holes about the centre, thus expediting the impregnation. The junction of the tube with the tree is carefully packed with a piece of cloth. The liquid advances through the tree at about the rate of one metre in twenty hours. The drip after passing through the wood is nearly colorless. A saw-cut around the tree to the depth of the sap-wood, with a piece of cotton cord tied in it, carries off the drip from any part above it. This is led back to the reservoir, to be again used with new material. — *President's Message, Part 1.*

At the Isle of Portland, England, where an immense breakwater is at present building, the numerous driving piles are impregnated with creosote, which is injected in the proportion of $1\frac{1}{2}$ gallons to the cubic foot, by a pressure of 160 pounds to the square inch. — *Editors.*

USE OF THE GASES ESCAPING FROM BLAST-FURNACES.

At the recent meeting of the British Association at Edinburgh, Mr. Palmer Budd detailed his mode of applying the gases escaping from blast-furnaces. He said it was well known that there are two descriptions of furnaces used for metallurgic purposes. The one is the blast-furnace, into which air is injected by mechanical means, at a great density, so as to penetrate upwards of forty feet of dense materials; and the other is the reverberatory furnace, where the fire is produced by means of the draft of a chimney-stack. What he had accomplished is by combining these two, so that the gaseous products of the furnace, instead of escaping through the funnel-head, are drawn sideways by a high stack, and, passing through the stoves and boilers, leave behind the necessary temperature of the blast and of the steam. In a blast-furnace the ores are smelted before the tuyeres, by the conversion of the solid carbon into carbonic acid, which, passing up through the middle region of the furnace into a bath of carbon, is reconverted into carbonic oxide, capable of combining with a farther dose of oxygen. It would be thus seen that the whole of the carbon of the fuel should be present at the top of the furnace in a gaseous form. Experience had proved that, by the aid of a stack, at the end of the chain, of sufficient dimensions, the gaseous escape from the furnace may be made to travel in the most tortuous directions, descending to the stoves built for heating by the usual fire-places, and traversing the boilers, the only condition absolutely necessary being that there should be an unbroken communication with the high stack at the end, into which the gaseous escape may at last pass, and by which it is drawn forward, instead of passing off wastefully at the funnel-head. When, however, the draft is carried downward, and to long distances, he had found it necessary to drop into the top of the furnace a hopper or funnel, made of sheet-iron, which acts as a shield at the mouths of the horizontal flues, and prevents them from either being affected by high winds, or from being choked up by materials thrown into the furnace. The reason, no doubt, why this funnel was not applied before, was the great apparent temperature at the funnel-head. In practice, however, it is found, that, until the gaseous escape mingles with the at-

mosphere, its heating power is not such as to injure sheet-iron, or even to make it red-hot. In fact, so long as there is an escape upwards, the iron funnel is not injured. The damage arises during and after stoppages of the furnace, when the blast is obstructed in its passage upwards by the settlement of the materials in the furnace, so that the atmosphere rushes down to meet the ascending gases, and of course causes a very high local temperature. His practice is to exclude the atmospheric air as much as possible. The affinity of the gases for oxygen is so great that the air-leakage raised the temperature quite sufficient for safety, whilst the full combustion of the gaseous escape would melt down the bricks in the flues and destroy the texture of the iron tube. It was not possible for him to say what combinations took place at high temperatures, where carbonic oxide, carbonic acid, hydrogen, and nitrogen are mixed in such proportions. At any rate, he found a smothered combustion to be the most suitable and economical for the purposes in view. He was quite aware that, by the plan he had pursued, the utmost heat is not extracted from the gases; and that, by different means, a temperature may be obtained capable of performing all the operations of the forge; and if it be true that the solid carbon of the furnace, in its escape as carbonic oxide, will unite with another dose of oxygen for saturation, there can be little doubt that, with properly constituted gas furnaces, there is enough at present passing off to convert the pig-iron into bar-iron. — *Civil Engineer and Architect's Journal*, Sept.

The *London Mining Journal*, for March 30, contains an account of the mode adopted by the Ebbw Vale Company, in South Wales, for collecting and using the gases from blast-furnaces. At these works there are 11 furnaces in blast, making from 1,400 to 1,500 tons of pig-iron per week; the five blast-engines have 25 boilers attached to them. At present, 19 of these boilers, with the gases applied to them, get sufficient steam to work the engines to their maximum duty, *without using coal*. The gases have also been applied to the pumping-engine, to several hot-air stoves, and are about to be applied to the calcination of iron stoves, moulders' stoves, and other purposes. The company thus save 1,000 tons of coal per week. The description is illustrated by diagrams, but can perhaps be rendered intelligible without them. Into the top of a blast-furnace of the usual description, a cylinder or tube is fixed, by which an annular chamber is formed round the inside of the furnace to receive the gases. This tube is made of common boiler-plate, three eighths or one half inch thick, with three-inch angle-iron riveted round the top, forming an outside flange, which rests upon the cast-iron ring usually placed on the top of the furnace immediately under the charging-plate. The diameter of this tube should be about twelve inches less than the inside of the furnace at the top, and the depth of the same six to seven feet. A little fine dust thrown round the angle-iron after the tube is lowered to its place makes a perfect joint. An orifice is made through the brick-work of the furnace, in which is inserted the pipe for conveying the gas from the annular chamber to the place of combustion. This pipe leads into a box resting on the brick-work, into which the gases are thus brought,

previous to entering the tube of the boiler. In this box is a slanting door, for the purpose of cleaning the tubes, as well as for safety in case of explosion, when it is forced open, thereby preventing injury to the flues. Beneath this first box is another box or burner, made of thin sheet-iron, having an opening nine inches by three fourths of an inch, through which atmospheric air in thin sheets is admitted to consume the gases, the top being placed on a level with that of the tube. The gases thus pass from the first box to the entrance of the boiler-tube, where the air is admitted through the burner or burners, and the whole is ignited by means of a little fire placed at the entrance, and inside the door, care being taken to prepare this fire a short time before bringing down the gases. Combustion then takes place in and through the tube, a side flue, and back along the flue to the stack. Holes are left in the brick-work so that the combustion of the gas can be seen, and the gases are easily shut off when it is desirable.

HYDROSTATIC BLOWING-PIPE.

THE *Scientific American*, for March 2, describes a "hydrostatic blowing-pipe" for producing the blast of air required in smelting and heating operations. It consists generally of a wheel or drum placed in a cistern or flume, with air-cells, a reservoir for air, and valves between the two heads of the drum. The air-cells on the periphery of the drum are so many boxes with valves on the bottom. As the wheel is turned, these boxes are successively plunged into the water while in an inverted position, and the air with which they were filled when entering it is forced through their valves into the drum of the wheel, by the pressure of the water from below, the strength of the blast being thus determined by the depth of immersion. Water is let into the flume until about one third of the diameter of the wheel is immersed. Where water-power is abundant, paddles or buckets may be placed on the wheels, and a current of about four miles an hour given to the water, which will turn the wheel and produce the blast. Where economy of power is desired, the blowing-wheel may be suspended in a cistern or circular trough, and turned by steam or any other power. The claims of this machine are founded upon its economy and simplicity.

IMPROVEMENTS IN FORGING AND IN WELDING IRON.

MR. NASMYTH described to the British Association, at Edinburgh, an improvement of his, which tends to increase the certainty of the production of perfectly sound and solid cylindrical forgings, especially those of large size, such as shafts, axles, and the like. In the common method, by which the metal is placed upon a flat anvil, the effect of the hammer is to spread the metal out in one direction, and this must be corrected by turning it round, so that each successive blow may correct the spreading caused by the previous one. This causes a fretting or mincing of the centre part of the metal of the shaft or other forging, resulting in a separation of the metal throughout the entire

centre, frequently to such an extent as to permit the passage of air or water from end to end. This evil Mr. N. corrects by using a wedge-shaped, or V anvil, between the jaws of which the work to be hammered is placed. In this case, instead of a tendency to spread, so as to render the central portion of the metal less compact and solid, we have exactly the opposite effect, besides which the article is more easily kept under the hammer, and the scales or impurities which fall from the hot iron fall down into the apex of the V out of the way, thus removing the blemish and roughness which is caused by the scales collecting on the face of the anvil and being beaten into the surface of the metal. The compressing effect of the blows, too, is so much enhanced that as much can be hammered out at one "heat" by the new anvil as in three "heats" by the common one. The angle of 80° is most generally suitable for the inclination of the sides of the V; the edges should be well rounded off and the surface of the V sides curved in the direction of the *axis* of the work, to the extent of one eighth of an inch in twelve inches, so as to be "proud" in the centre, and thus facilitate the extension (axis-ways) of the work. One anvil will accommodate forgings of all diameters, which are not so large as to rest on the upper corners, nor so small as to touch the apex. These anvils have been very extensively introduced.

Mr. Nasmyth also described an improvement in welding. He commenced by showing that the frequent defect in welding arises from the interposing of scoriæ or "cinder" between the welded surfaces, which prevent the two surfaces from being brought in contact at all points. The "slabs" produced under the action of a forge-hammer and anvil usually have some portions of their surfaces slightly concave, and the concavity is ordinarily such that the parts which come into contact first are the exterior edges. The blows of the hammer weld the parts in natural contact, and in a greater or less degree expel the scoriæ, which will escape as long as there is a passage out, but if, as has been said is generally the case, the exterior portion of the surfaces of the slabs is the first welded, the scoriæ must remain, and no amount of hammering can remove them, and thus we have an unsound welding. The remedy for this great evil is a very simple one. It is only necessary so to form the surfaces to be welded that a free exit may be preserved to the last for the scoriæ, and this is done by making one of the surfaces slightly convex, so that the welding begins at the centre and proceeds outwards, thus forcing out all the scoriæ, and allowing complete contact. — *Civil Engineer and Architect's Journal*, Sept.

IMPROVEMENT IN THE MANUFACTURE OF IRON.

THE *Jerseyman* describes a new process for making iron, the invention of Mr. A. Dickson, of Newark. The fire is placed at the end, under a horizontal bed of fire-brick some twelve or fifteen feet in length, the fire passing through to the other extremity. In the centre and over the bed is erected a double cylinder, which is filled with crushed ore and pulverized anthracite coal. The intense flame surrounds the cylinders, and also passes through the centre by the inner

one, which removes the oxygen gas and all other impurities, with the presence of atmospheric air. Being thus prepared, the ore melts and descends to the hearth, where it first comes in contact with the fire, which destroys the rest of the pulverized coal by frequent stirring, and the iron is thus partially formed. From this hearth it is thrown to another about eight inches lower down, where it is worked into balls of about one hundred pounds amid the same sheet of fire, and in a few minutes the balls are withdrawn, and placed under the hammer to shape them. — *Scientific American*, Jan. 26.

MR. PLANT, a well-known practical miner, has invented an improvement in the manufacture of iron, which, although it lies in a small compass, is, nevertheless, to all appearances, based on scientific principles, the main feature of the invention being the application of steam, conjointly with hot or cold blast, into the puddling and preparatory chambers of the puddling-furnace, and by these means the heat in the puddling-chamber is regulated. — *London Mining Journal*, Jan. 26.

IMPROVED METHOD OF PRODUCING IRON AND STEEL.

SIR F. C. KNOWLES has patented a process for the production of iron and steel directly from the ore. For the first process, — that of making the iron directly from the ore, without any previous smelting, — he selects those ores most free from earthy matter, and the nearer they approach to pure oxides the better. For the other process of preparing iron ores by cementation in retorts, to make cast-iron by smelting afterwards, the ores are taken indifferently, excepting such as contain much sulphur and arsenic. They are first broken into pieces of moderate size, so as when placed together in a heap there may be interstices between them, capable of admitting a gas or vapor through them without obstruction. They are then placed in retorts, rendered gas-tight, and brought up to a red heat, each of which is connected with gas-tubes, having stopcocks for the purpose of injecting and regulating a current of gas among the ore. For this purpose two sorts of gases are used, common carburetted hydrogen and carbonic oxide prepared by slow combustion of charcoal or coke, though any economical hydro-carbon may be used. When the retorts are charged and the gas generated, the *rationale* of the process is as follows. The ore being mainly an oxide of iron, the hydrogen of the hydro-carbon unites with the oxygen of the ore to form water, while the carbon unites with another portion of oxygen, forming carbonic oxide or carbonic acid, as the case may be, leaving metallic iron as the result. The next process, when malleable iron is the proposed product, is to shut off the gas on both sides of the retorts, and transfer their contents to the puddling-furnaces, where the iron is treated in the common way. It may be cut, piled, re-heated, and rolled as usual. If steel be required, the cementation must be carried further, until the reduced metal has absorbed about 1 per cent. of carbon. The reduced and cemented ore is then put into crucibles to be run down into ingots, in wind-furnaces, as is now done in the making of cast-steel. If the earthy matter in the ore require it, some proper flux is to be added

according to the usual method. If cast-iron be required, the cementation must be carried on until about 3 or 4 per cent. of carbon is absorbed, after which it is transferred to the blast-furnace, with a proper flux. Among the other claims of the patentee is one for the use of spathose iron ores and "soft mine" as a flux, to supersede limestone, the ore being first roasted, to drive out the carbonic acid, and then mixed with other ores in such proportion that the lime contained in the aggregate may bear a due proportion to the silica and alumina in the other iron ores to be smelted. — *London Mining Journal*, July 19.

MANUFACTURE OF STEEL.

MR. J. M. HEATH has taken out a patent for some improvements in the manufacture of steel, which consist in the application of iron, produced from iron ores without being brought to the state of pig or cast iron, to the manufacture of steel, the iron so produced being manufactured by a process which renders it more suitable for conversion into steel than the iron commonly used. The excellence of the steel depends upon the freedom from mixture with impurities, which impurities can never be entirely removed from the metal by the operations in use for converting the pig into malleable iron. Any pure ore or oxide of iron, from which the extraneous matters can be easily separated, may be used, but the magnetic ore is preferred. It is reduced to the state of grains, or even of fine powder, to facilitate the separation of the extraneous substances, after which the pure ore is to be reduced to the metallic state by any of the well-known processes for depriving the metal of oxygen, by acting upon it with carbon, or any reducing agent, at a heat below that required to bring the metal to the fluid state. The metallic product obtained in this way, when operating upon the manufacturing scale, can never be absolutely free from all impurity, and it always contains some portion of oxide of iron as it comes from the process of deoxidation. To make perfect steel-iron, however, the patentee takes the metallic product, as it comes from the process of cementation or deoxidation, and mixes it with a small portion of oxide, or chloride of manganese, and a certain portion of coal or fir tar, or any cheap hydro-carbon or carbonaceous matter. The best results are obtained from the mixture of from one to three pounds of manganese and from one to two gallons of coal or other tar to each hundred pounds of deoxidated ore. The mixture of granular iron, tar, and manganese, resulting from this process, is heated in a suitable furnace, and when the iron is at a welding heat, it is removed from the furnace, and subjected to compression in order to be formed into a solid bloom by any of the usual processes. The bloom is then to be re-heated and shingled, hammered, or rolled into bars in the usual manner, after which it may be converted into steel by the well-known processes, and will be found superior to that made from the best iron hitherto procurable. — *Civil Engineer and Architect's Journal*, July.

At the meeting of the American Association, at New Haven, specimens of iron were exhibited, made at Franklin, N. J., from Frank-

linite, an ore of iron containing manganese. This iron was far more tenacious and fibrous than the best Swedish, bending readily double, in some instances, where the Swedish broke short off.

SMELTING MAGNETIC IRON ORES.

THE *Journal of the Franklin Institute*, for February, contains a paper by Mr. H. Fairbairn, on "smelting magnetic iron ores." The author states that these ores of iron are found in New Jersey, Pennsylvania, New York, Maryland, Virginia, South Carolina, and many of the Southwestern States, but are most known, in a manufacturing point of view, in New Jersey and Pennsylvania, especially on the banks of the Lehigh. They are the richest of all the ores of iron, being not only productive of iron in the greatest quantities, but the iron is of very fine quality. In this country great difficulty has been experienced in smelting this species of ore without adding an admixture of hematite, a poorer variety, and though one or two furnaces have at times smelted the ore pure, the damage to the furnace was found to be so great that the attempt was soon abandoned, so that it is generally considered that it is not practicable to smelt the magnetic oxide of iron, with profit to the manufacturer, unless with the admixture of considerably more than one half of the inferior hematite ore. But this admixture deteriorates the quality of the metal, and is fatal to any competition with Russian iron.

It is therefore of great importance to overcome this difficulty; and that it can be overcome is shown by the fact, that iron equal to the Russian, produced from the magnetic ores, is from time to time exhibited in this country. The author thinks that the waste of limestone in the smelting-furnace is one of the leading causes of the unsuccessful attempts to produce iron for steel from the magnetic ores of the Lehigh, and urges that, if the earthy ingredients in the ores be only 10 per cent., 1 cwt. of limestone is the true quantity to be used in the smelting-furnace. Another important error is the filling the furnaces with the ores in an insufficiently reduced state. This variety of iron ore, being of great specific gravity, naturally tends to fall through and below the coals, the limestone and the other ores in the furnace at the same time lying impressed against the boshes, obstructing the blast, impeding its own reduction, and causing much of the superincumbent coal to be lost to the process of smelting and wasted at the tunnel-head. The remedy for this is to be found in reducing the magnetic ores to the smallest size, and also in filling the furnace with the ores more intimately mixed with the limestone and the coals.

The internal form of the furnaces on the Lehigh, which is cylindrical, is another impediment to the successful smelting of these heavy ores, which press with great force, owing to their increased weight, against the walls of a furnace with an imperfect internal curve. The Stanhope furnaces, where the magnetic ores are smelted without any admixture of hematite, are true circles. The author thinks there can be no truth in the usual reasoning of the proprietors of iron-works, that the use of the hot-blast is the cause of the difficulty in the production of iron for the purposes of steel.

If these suggestions are followed out, with others which the advancement of knowledge will indicate, the author believes that American iron, manufactured from magnetic ores, will not only drive Russian, Norwegian, and Swedish iron from our own market, but compete with those nations in that of Great Britain.

NEW COMPOUND RAIL.

IN the subdivision of railroads, two patents for improved compound rails deserve notice. The construction of one of these may be described as follows. Saw or split in two any line of ordinary T rails in the direction of their length, which would leave, besides the usual openings at the junctions, another slit the whole length of the track from top to bottom of the rail; then draw one set of halves in either direction, until the junctions between its parts come midway between the junctions of the other set, and bolt the whole together by transverse bolts. A compound break-joint rail is thus formed, preventing to a great extent the jar experienced in passing from one rail to another, and rendering them less liable to be thrown from their proper place on the track. The other rail may be styled an improvement on this one. It has the same peculiarities, but in addition, the sets of halves are formed in such a manner as to leave a continuous hollow or tubular space the whole length of the rail, into which are inserted at the junctions, iron cores, rendering the rail firmer at these weak points. It differs likewise in its exterior form, its cross-section being such as would be produced by rounding off the corners of a parallelogram, and bending in all its sides. The rail is thus, as it wears, susceptible of four reversals. A chair peculiarly fitted for supporting it forms a part of the invention. — *Patent Office Report*, 1849.

IRON AS A MATERIAL FOR SHIP-BUILDING.

MR. GRANTHAM, in a paper read before the Liverpool Polytechnic Society, after alluding to the many advantages to be derived from the use of iron as a material for ships, and the difficulty caused by their bottoms becoming foul, which has hitherto prevented its general use, proposes to cover the iron with wood. This he does by placing the ribs of the vessel on the outside of the iron, over which a thin sheathing of wood is laid, and coppered in the usual manner. — *London Mining Journal*.

THE EFFECT OF SHOT AND SHELLS ON THE HULL OF IRON VESSELS.

EXPERIMENTS for testing the effects of shot and shells on the sides of iron vessels have recently been instituted, under the direction of government, at Portsmouth, England, in the presence of large numbers of military and scientific men. A large butt had been made in the dock-yard, representing the two sides of an iron vessel, each side of the strength and consistency of one of the large iron steam-ships.

This butt was erected on the mud, at a distance of 460 yards, and the practice took place at high water from guns of several calibres, and various charges of powder, both shot and shells, were fired. At intervals between the firing, boats visited the butt to examine the effects of particular shot on the iron work. It was found that on the side that the shot entered a large and tolerably round hole was made in the iron plate, the circumference being much jagged and the edge turned inward. On the opposite side, where the shot passed out, the hole was larger and also jagged, the edge of the hole turned outwards, with occasionally some rivets started. Some of the shot on entering, and from striking against angles of the iron ribs, were broken in pieces, the fragments passing out at the opposite sides, making holes of various sizes and forms. Shells also appeared to have a very destructive effect on the iron-work in creating splinters, and the pieces of shell passing out through the plates at the opposite side, the off-side in all cases suffering most. Of course, neither shot, nor shells, nor grape, nor canister would lodge in iron vessels, as would be the case in wooden vessels. To test the effect of the splinters inside the vessel, a slight plank bulkhead had been run up between the iron sides of the butt. This was found entirely shattered, and shows clearly how dreadfully the crew of an iron vessel would have suffered, more especially when it is considered that the splinters from the jagged iron inflict the most dangerous description of wound, even a slight one predisposing the party hurt to tetanus or lock-jaw, and otherwise being most difficult to cure. From the experiments made, it is certain that iron vessels are not fit to cope with vessels of wood; neither are they fit to go against batteries; for it is now tolerably certain that the fatal effects of every shot received on board would be quadrupled by the tendency of the iron-work to splinter, fly off, and destroy every thing in the immediate vicinity of the concussion, more especially when the ball itself is also likely to split and break to pieces.

With a view of remedying the destructive effects of shot on iron vessels, Lt. Walter, R. N., has invented a preparation which he calls *Kamptulicon*. It is a composition, the principal ingredients being India-rubber and sawdust, and it is proposed to line the sides of iron vessels with it, to the thickness of twelve inches. The projector asserts that, from the peculiarly adhesive qualities of the prepared solution with which it is applied, the necessity of any fastening is obviated; that it closes, by collapsing, the hole made by the entrance of shot; that it receives and imbeds in itself the terribly dangerous splinters; that it deadens concussion; and lastly, that its buoyancy will keep a ship afloat, even if riddled with shot. The result of some experiments has been also published, the object of which was principally to test the practicability of its adhesion to the iron, without the use of bolt or bar of any kind. A target of iron, six feet square, to which the *Kamptulicon* lining was attached by means of a solution prepared for the purpose, was erected at a distance of forty yards from a thirty-two-pounder. Four shots were fired with the iron surface presented, with a very curious effect, two of which deserve especial notice; namely, the third, which, fired with a reduced charge, to represent a long range,

lodged in the material; and the fourth, which, with still further reduced charge, fell without doing injury at the base of the target. It was then turned round, with the *Kamptulicon* lining towards the gun, at which four shots were also fired. The first two passed through with nearly the same effect, opening the iron to a considerable extent, but the lining closed up immediately, so as scarcely to admit the insertion of a small cane at either end, the centre being quite close. The fourth shot, fired with a very reduced charge, rebounded about fifteen yards in a direct line; thus proving that a shot at a long range would not even enter a vessel so lined. It may also be presumed, from the wonderful resistance of the material, and its repellent power, that nothing under a full charge would fire a shot through the two sides. As to its adhesive nature, it need only be said that it occupied a dozen strong men, armed with handspikes and crowbars, a considerable time to detach it from the iron after all this battering. In small portions cut from the different targets may be seen large pieces of iron imbedded, which might cause frightful wounds, and even death, if scattered amongst the crew.

GLASS COATING FOR IRON ARTICLES.

At the late *soirée* of the President of the Institute of Civil Engineers, some specimens of iron manufacture coated with glass were exhibited. In coating plates, roofing-tiles, tubing, kettles, &c., the article is first cleansed in an acid solution, and then covered with a glutinous preparation, over which is laid a coat of glass, ground to a fine powder. The article is then introduced into a furnace of a peculiar construction, in which the glass is fused, and, the intermediate glutinous matter being evaporated, the glass fills the external pores of the metal, and becomes firmly united to it. In ornamental dinner-plates, foliage and designs are given in relief, executed by a kind of stencilling; one color being put on, it is transferred to the kiln and fixed; when cold, another color is added, and so on. — *London Mining Journal*, June 8.

PROTECTION OF IRON FROM OXIDATION.

At the Exposition at Paris, in 1849, there were exhibited numerous articles manufactured of iron, covered with a kind of transparent vitreous coating, completely spread over the surface of the metal, like a varnish, and capable of affording a perfect protection against the action of the air, or any other oxidizing agent. This invention may be applied to forge or cast iron, no matter what may be the shape of the article. The following is stated to be the process employed in imparting to the iron the vitreous surface. The object is thoroughly cleansed by dilute acid, after which it is well washed and dried. It is then brushed over with a tolerably strong solution of gum Arabic. Over the whole of the gummed surface, powdered glass of a peculiar kind is then sifted, care being taken that every part of the surface is well covered. When thus prepared, the work is introduced into a furnace

or retort heated at from 212° to 302° F., and, when thoroughly dry, it is removed to another furnace, where it is brought to a cherry-red heat; the adhering vitreous matter now fuses, and when the fusion is complete and the glass seems to have flowed over the whole surface, the article is removed from the furnace and placed in a close chamber, from which the air is entirely excluded, where it is kept till it has cooled down to the temperature of the atmosphere. The vitreous compound used consists of the following substances:—Powdered flint-glass, 130 parts; carbonate of soda, $20\frac{1}{2}$ parts; boracic acid, 12 parts. These must be melted together in a "glass pot," and a fusible glass will be the result; when cold, this must be pounded with care, so as to be reduced to a powder fine enough to pass through a silk sieve. If the first coating is found to be imperfect, a second one may be applied; but in all cases the vitreous matter and the metal must be quite free from all foreign matter. — *Civil Engineer and Architect's Journal, Feb.*

COATING FOR CAST-IRON.

MR. W. WYATT has patented a glaze, consisting of three parts, by weight, of white-lead (or one part of red-lead and two parts of white-lead) to two parts of borax and one part of calcined flint, which are to be fused, run into water, and ground in a glaze-mill to the consistency of cream. The article coated is to be placed in a kiln in such a way that no flame or sulphur shall touch it, and heated till the glaze melts. — *London Builder, May.*

COATING IRON WITH COPPER.

MR. E. G. POMEROY, of St. Louis, has patented a process for coating iron with copper. All impurities are first removed by an acid, after which the iron is dipped into clay moist enough to leave a thin coating upon it. It is then dried over a brisk fire, and immersed in molten copper, when enough of the latter adheres to it to cover it completely. It may afterwards be smoothed and polished by rollers. Hammering does not separate the copper from the iron. — *Farmer and Mechanic, Sept. 19.*

TENACITY OF METALS.

As the results of numerous experiments, M. Baudrimont has arrived at the following conclusions:—1. The tenacity of metals varies with their temperature. 2. It generally decreases, though not without exception, as the temperature rises. 3. With silver, the tenacity diminishes more rapidly than the temperature. 4. With copper, gold, platinum, and palladium, it decreases less rapidly than the temperature. 5. Iron presents a very peculiar and remarkable case; at 212° F. its tenacity is less than at 32° , but at 392° it is greater than at 32° . — *Comptes Rendus, July 29.*

RESHARPENING OLD FILES AND RASPS BY A CHEMICAL PROCESS.

THE *London Chemist* states that, by the following cheap and simple process, old files and rasps may be made nearly equal to new ones. First boil them in soap lyes, or a mixture of slacked lime and soda in water; this done, wash them in water, and directly throw them into a tub full of dilute sulphuric acid, formed of one part acid and six parts water; let them remain here for some time, the exact period being easily found by taking out a file and observing whether the nicks appear sharp or not; as soon as the desired sharpening is effected, the files must be taken out and washed in another tub containing a solution of soda, about an ounce of soda to a pail of water.

CLEANSING OF METAL CASTINGS.

IN the old process of cleansing of metal castings, by water containing sulphuric or hydrochloric acid, the coating is more or less perfectly removed, but the surfaces are left rough and unequal. Messrs. Thomas and Delisse found that the coating was removed from cast surfaces with great certainty, when, to water acidulated with sulphuric acid, organic matter, such as glycerine, artificial tannin, naphthaline, creosote, or stearine was added. This acid liquor does not dissolve the coating, but detaches it, and causes it to scale off, leaving untouched the metal below. By this process, which is peculiarly applicable to the cleansing of zinc and brass, sixty per cent. of acid is saved, and not half as much metal lost as in the old process. But the organic substances mentioned above being difficult to procure in many instances, M. Elsner applied himself to discover some cheaper and more easily procurable organic matter which would answer as well, and he has found that both wood and coal tar answer perfectly well. A piece of iron casting was immersed in a mixture of tar and dilute acid, and was completely cleansed, without any disengagement of hydrogen gas, the surface being left of a clear, grayish-black color, quite clean and smooth, and totally unattacked by the acid. A similar casting immersed in the solution ordinarily used in this process was almost wholly dissolved in an equal time. — *Technologiste*.

ALLOYS OF MANGANESE AND IRON.

DR. JACKSON exhibited to the Boston Society of Natural History, in January, several specimens of white cast-iron containing manganese. The iron was remarkably crystalline and brittle, and resembled in color pure antimony. Specimens containing five per cent. of manganese crystallized into broad lamellæ, and cleaved readily into crystalline forms. Specimens containing nine per cent. were more highly crystalline, with broad plates of crystals intersecting each other, giving the broken surface of the pig the appearance of meteoric iron that had been acted on by acids. The specific gravity of the first specimens was 7.684; of the second, which contained three per cent. more manganese, 7.488. In specimens containing sixteen per cent

of manganese, manufactured from a manganesian red hematite, the metal was hard, white, and granular-crystalline, with few intersecting plates of crystals. The specific gravity was 7.330. These alloys of manganese and iron are not generally understood by iron masters, founders, and refiners, and are frequently mistaken for iron containing sulphur or phosphorus. Manganesian iron is unfit for foundry purposes, but makes the best kinds of malleable wrought-iron when refined in the forge or puddling-furnace. It "comes to nature" slowly, and hence makes a good mixture with iron rich in carbon, which "comes to nature too quickly," and is liable, therefore to be badly refined, breaking up under the tilt-hammer, or "brooming up" in the process of hammering. It is obvious that there is a loss in weight in iron in purchasing the highly manganesian irons, but in those containing but little manganese it is of no account, since it merely displaces a certain proportion of carbon. It appears from the relative specific gravity of the samples analyzed, that a highly manganesian iron may be readily known, its specific gravity being less than that of ordinary white carboniferous iron.

MALLEABLE BRASS.

M. ELSNER, in a Prussian periodical, says it is well known that common brass, containing from 27.4 to 31.8 per cent. of zinc, and from 71.9 to 65.8 per cent. of copper, is not malleable while hot, but it is of great importance to have an alloy of this kind which is malleable. M. Machts has found that, by melting together thirty-three parts of copper and twenty-five parts of zinc, there is a loss of three parts, thus making sixty per cent. of zinc and forty per cent. of copper. The color of this alloy is between that of brass and tombac; it has a strong metallic lustre, a fine close-grained fracture, and great solidity. Its hardness is the same as that of fluor spar; it is consequently harder than copper, is very tough, and in a properly managed fire is malleable, so much so that a key was formed out of a cast rod. In melting the metals together, care must be taken not to permit too great a loss of zinc. — *London Mining Journal*, Nov. 9.

ACCURATE AND SUCCESSFUL ENGINEERING.

A HIGHLY successful and curious feat in engineering was accomplished in the month of September, at Seaford, England, in the blowing down, by one blast of gunpowder, an immense section of chalk cliff, the amount of which has been estimated at nearly 300,000 tons. The object in view was to obtain materials for the protection of a beach against the encroachments of the sea. The cliffs from which it was determined to obtain these materials are composed of chalk, and vary in height from two to three hundred feet. At a point about fifty feet above high-water-mark, there was excavated a tunnel or gallery seventy feet long, six feet high, five feet broad, ascending with a slope of one foot in three feet. At the inland extremity it turned right and left in the heart of the cliff, above fifty feet one way and above sixty the

other, with a more gentle ascent, the two smaller galleries being four feet six inches high, and three feet six inches broad, and the three being in the form of a capital T. At the farther end of each of the side or cross galleries was a chamber, seven feet cube, lined with wood; and in each chamber a charge of no less than 12,000 pounds of gunpowder was deposited; making the distance of the centre of the charge seventy feet from the face of the cliff towards the sea, and about seventy feet above high-water-mark. The galleries were "tamped," that is, stopped up, with bags of sand, and chalk in bags and loose, to within fifty feet of the mouth, both branches being tamped up, and twenty feet down the large gallery. Above this charge of powder, and on the top of the cliff, three shafts were sunk to the depth of forty-one feet, and 600 pounds of powder deposited in each. These pits were tamped with chalk. 180 feet from the edge of the cliff, a small wooden house was erected, in which were placed three voltaic batteries, two of Groves's and one of Smee's, for firing the charges. Extending from each deposit of powder, and connecting with the batteries, wires, covered with tape and varnished, were deposited, for the purpose of conveying the electric spark; the wires for the two lower charges being carried over the top of the cliff. It was arranged that the two great charges should be fired simultaneously, and the others a few moments afterwards.

A correspondent of the *London Times* gives the following description of the explosion:—"As the appointed hour drew near, every eye was fixed upon the place where the explosion was to be, marked out as it was by a flag upon its highest point. It was not till twelve minutes past three o'clock, that suddenly the whole cliff, along a width or frontage of some 120 feet, bent towards the sea, cracked in every direction, crumbled into pieces, and fell upon the beach in front of it, forming a bank, down which large portions of the falling mass glided slowly into the sea for several yards, like a stream of lava flowing into the water. There was no very loud report; the rumbling noise was probably not heard a mile off, and was perhaps caused by the splitting of the cliff and fall of the fragments. There seemed to be no smoke, but there was a tremendous shower of dust. Those who were in boats a little way out state that they felt a slight shock. It was much stronger on the top of the cliff. Persons standing there felt staggered by the shaking of the ground, and one of the batteries was thrown down by it. In Seaford, too, three quarters of a mile off, glasses upon the table were shaken, and one chimney fell. The mass which came down is larger than was expected; it forms an irregular heap, apparently about 300 feet broad, of a height varying from 40 to 100 feet, and extending 200 or 250 feet more seaward, which is considerably beyond low-water-mark." The effect produced was caused entirely by the two great charges in the lower chambers, as the wires to the pits on the top of the cliff became disrupted by the explosion below, before a current could be passed through them to the powder at their termination. The execution of this work was performed under the direction of the Board of Ordnance, by a corps of 55 men belonging to the Sappers and Miners. The time occupied was about seven weeks.

TUNNELLING THE ALPS.

To complete a direct line of railroad communication between Boulogne, Venice, and Ancona, and consequently between London and the Adriatic, only one obstacle lies in the way. The chain of Mont Cenis and Mont Genève, running nearly northeast and southwest, would cross such a line, and present with the elevation of 11,000 feet an insurmountable bar to any direct and continuous railway. The railway can with some difficulty be made to Modane, at the foot of the northern crest of the Graian and Cottian Alps; but here it must stop, unless a subterranean passage can be found through the mountains, and a project for doing this has been for several years under consideration by the Sardinian government. Chevalier Henry Maus has devoted much study to making the examinations and calculations, and has invented a new boring machine for the purpose of carrying out the plan. He made his report early in 1849, and a commission of engineers, army officers, and geologists was appointed to examine into the feasibility of the project. Their report, illustrated by maps, has just been published, and an application for a part of the funds to begin the work will be made forthwith. The tunnel is expected to cost about \$3,000,000, and may be finished in five years. It will measure 12,290 metres, or nearly 7 miles in length. Its greatest height will be 19 feet, and its width 25, admitting, of course, of a double line of rail. Its northern entrance is to be at Modane, and the southern entrance at Bardonnèche, on the river Mardovine. This latter entrance, being the highest point of the intended line of rail, will be 4,092 feet above the level of the sea, and yet 2,400 feet below the highest or culminating point of the great road, or pass, over the Mont Cenis. It is intended to divide the connecting lines of rail leading to either entrance of the tunnel into eight inclined planes of about 5,000 metres, or $2\frac{1}{2}$ English miles each, worked like those at Liege by endless cables and stationary engines, but in the present case moved by water-power derived from the torrents. At one point there will be 4,850 feet of mountain, capped with eternal glaciers, overhead. Ventilation must be maintained by forcing air in and out by mechanical means.

The newly-invented machine, which it is proposed to use, consists of two large hydraulic wheels, 18 feet in diameter, which move two pulleys (with an endless cable passed twice round them) placed horizontally, and of 30 feet diameter, performing $22\frac{1}{2}$ revolutions per minute. There is also an endless cable connected with the excavating machinery, to move at the rate of 35 feet per second, and a counterpoise or weight to keep the cable in a proper state of tension at the opposite end of the hydraulic wheels, and to travel on a wagon between these and a great well, sunk to receive a corresponding weight at the end of a rope. The machine, once presented to the rock, projects into it simultaneously four horizontal series of sixteen scalpels, working backward and forward, by means of springs cased in, and put in operation by the same water-power. While these are at work, one vertical series on each side works simultaneously up and down, so that together they cut out four blocks on all sides, except on the rock

behind, from which they are afterwards detached by hand. During the operation, a squirt-pump throws out a jet of water between each pair of scalpels, to prevent the heating of the tools, and to wash out the rubbish. After their complete separation, the blocks are pulled out by the help of the endless cable, and received in a wagon, to be drawn from the tunnel. The machines are only to cut a gallery 13 feet wide and 7 feet high, which is afterwards to be enlarged by the ordinary means to the size mentioned above. It has already been ascertained that each of the two machines, at the opposite ends of the tunnel, will excavate to the extent of 22 feet per day, and it is to be estimated that the whole excavation will be completed in four years. The rocks which it is supposed will be met with are gypsum, limestone, and quartz in veins.

BUILDING FOR THE EXHIBITION OF 1851.

At the meeting of the Society of Arts, on Nov. 13, Mr. Paxton, the architect and designer of the building for the exhibition of 1851, gave an account of that structure. Mr. P. is chief gardener of the Duke of Devonshire, and under his care several conservatories of enormous size have been erected, and the building for the exhibition is, in general, a mere expansion of the idea followed in them; so much so, that it was designed and planned in ten days. Not a particle of stone, brick, or mortar is necessary to be used. The building is 1,851 feet long, and 456 feet broad in the widest part. It covers more than 18 acres, and the whole is supported on cast-iron pillars, united by bolts and nuts, fixed to flanges turned perfectly true, and resting on concrete foundations. The total cubic contents are 33,000,000 feet. The six longitudinal galleries, 24 feet wide, running the whole length of the building, and the four transverse ones of the same dimensions, afford 25 per cent. additional exhibiting surface to that provided on the ground-floor. In order to give the roof a light and graceful appearance it is built on the ridge and furrow principle, in which, instead of rising in a regular slanting direction to one ridge or apex, it is composed, as it were, of several small roofs, the apices of which are on a level. It is glazed with plate-glass. The rafters are continued in uninterrupted lines the whole length of the building. The transept portion, although covered by a semicircular roof, is also on the angular principle. All the roof and upright sashes are made by machinery. The length of sash-bar requisite is 205 miles. The quantity of glass is about 900,000 feet, weighing upwards of 400 tons. The lower tier of the building, however, will be boarded with fillets, planted on in a perpendicular line with the sash-bars above. By means of gutters of a peculiar construction, rain-water is conveyed to the hollow columns, and thence to the drains below. The floor consists of trellised wooden pathways, with openings between the boards, into which the dirt can be swept, so as to fall into the empty space below. Ventilation is obtained by making four feet round the whole of the basement part of the building of *louvre-boarding*, and at the top of each tier a similar provision of three feet is made, with power to obtain an additional

quantity if required. In the centre aisle, also, the air will be plentifully admitted, and by simple machinery the whole of the ventilation can be easily regulated. In order to subdue the intense light in so large a building covered with glass, all the south side of the upright parts, and the whole of the angled roof, are to be covered with canvas or calico, so fixed as to allow a current of air to pass between the canvas and the roof. Magnifying-glasses, working on swivels, placed at short distances in the galleries and elsewhere, will aid in affording a perfect general view of the Exhibition.

From other sources we learn that on the north side of the main building is another apartment 936 feet long and 48 feet wide, to contain machinery. The height of the building is 66 feet, except in the transept, which is 108 feet high, so as to inclose a group of trees. The main parallelogram is formed into 11 divisions longitudinally, alternately 24 feet and 48 feet wide, with the exception of the great central walk, which is 72 feet wide.

TEST FOR LUBRICATING COMPOUNDS.

MR. JAMES NASMYTH has invented a test of the quality of various kinds of oil for lubricating purposes, which, he claims, is superior to any other. It is founded on the assumption, that permanent fluidity is the valuable quality in any lubricating compound, and that many oils, such as linseed, though they at first answer capitally the purpose intended, become thick and viscid after one or two days' use, so as to be worthless. The test consists simply of a plate of iron, 4 inches wide by 6 feet long, on the upper surface of which are six equal-sized grooves. The plate is placed in an inclining position, say one inch in six feet, and equal quantities of the various kinds of lubricating substances are poured into the grooves. That which retains its fluidity longest will reach the bottom first, though other oils may keep ahead of it for two or three days. — *London Mining Journal*, March 30.

NATURAL PHILOSOPHY.

PAGE'S EXPERIMENTS ON ELECTRO-MAGNETISM.

CONGRESS, it is well known, some time since made an appropriation to enable Professor Page, of Washington, to test upon an extensive scale the applicability of electro-magnetism as a motive-power. From the reports published in the *National Intelligencer*, and from other sources, we have prepared the following abstract of those results obtained by Professor Page which have as yet been made public.

It is known that, when a helix of suitable power is connected with the poles of a battery in action, an iron bar within it will remain held up by the induced magnetism, although the helix be put in a vertical position; and if the bar be partially drawn out of the helix by the hand, it goes back with a spring when left free again. This power, the action of the helix upon the metallic bar within it, is the power used in Professor Page's engine. The power, when a single coil is used, has its points of greatest and weakest force, and in this condition is objectionable. But, by making the coil to consist of a series of short, independent helices, which are to be brought into action successively, the metallic rod is made to pass through the coil and back again with great rapidity and with an equable motion. In all the engines hitherto used, there is a loss of power at the instant of the change of current, owing to the production of a secondary current moving in an opposite direction, and this loss is the reason why these engines cannot be rendered available. Professor Page had in view the obviating of this difficulty when he commenced his investigations, and has had full success in his invention.

The first principal experiments were made with a small trial-engine, built expressly for the purpose, and with the utmost care in reference to mechanical accuracy. Attached to this was a dynamometer of new construction, which measured in a most satisfactory manner the dynamic power of the engine, at any given velocity, a great desideratum in estimating this new power. With this trial-engine the following important questions were tested:—1. The dynamic values of different qualities of soft iron. 2. Of steel, hard and soft. 3. Of cast-iron. (The

statical values of all these varieties were tested by a separate apparatus, called the axial galvanometer. Twelve varieties in all were so tested, in bars of uniform size, one foot in length, and one inch in diameter, and it was found that the statical and dynamic properties corresponded.) 4. The proportions of the helices, approximately, though much remains unsettled upon this important point. 5. The advantages of keeping up the magnetism in the axial bar. 6. Various modes of reversing the motion of the engine, and with success. 7. Various kinds of cut-off (which is the most critical and important point in the construction of the engine). 8. The operation of closed circuits and secondary currents was tested with great care and accuracy. 9. The best working velocity of this engine, and its absolute power with a given battery. 10. The ratio of increase of power, with an increase in the quantity of the current. 11. The values of different kinds of metal in forming the cut-off. Various other minor points were also the subject of experiment, after which experiments were commenced upon a larger scale, with a view to determine whether the same proportion of power could be obtained from large as from small engines, this being the principal question in view at the time of the appropriation. A large number of helices were constructed, of various sizes, and suitable bars of soft iron, corresponding to the helices, both hollow and solid, from two inches to eight inches in diameter, and generally three feet in length, were prepared. There were also some bars of four and five feet in length. With these bars and helices a multitude of experiments were performed and recorded daily for about two months. They were not such as could be performed upon the laboratory table; but were made with masses of iron, weighing in some cases three hundred pounds, and helices sometimes twice that weight.

“Adhering to the same size of battery through a long course of experiments, and varying the coils and bars, I found, to my great gratification, that, as I increased the dimensions of each, a corresponding increase of power was exhibited, and the consumption of material, or the cost of the power, in some proportion diminished. These results fully justified the undertaking at once of an engine upon a much larger scale than any hitherto tried. This engine was an upright engine of two feet stroke; and in order to have facilities for comparative trials and experiments, it was necessary that a double engine should be made, the two parts exactly corresponding. Two bars of soft iron, six inches in diameter and three feet in length, were the prime movers, and these were balanced by means of connecting rods and cranks upon a fly-wheel shaft. The balance-wheel and shaft together weighed six hundred pounds. When this engine was first tried, with the same battery which had before given me one fifth of a horse-power with a smaller engine, it produced only one third of a horse-power. By careful attention to the adjustments, and particularly to the cut-off, which was a very different thing now from what it had been in smaller engines, the engine soon yielded one horse-power. Here was a gain of eighty per cent., as measured merely by the size of the battery. But it was much more; for the cost was found to be less for one horse-

power than it had been before for one fifth of a horse-power, in a smaller engine. A great variety of experiments were made with this engine, until finally, by little daily increments, I obtained, by a trifling addition of battery, a full two horse-power. By way of giving practical character to this engine, it was geared to a circular saw ten inches in diameter, a turning-lathe, and grindstone, all of which it worked simultaneously. After many satisfactory trials with this engine, it was taken down, and all its available parts used in the construction of a single horizontal engine, which was exhibited before the Smithsonian Institution. This change was made for the purpose of dispensing with the dead weight of one of the driving bars, and more particularly for introducing the important feature of keeping up the magnetism of the driving bar. As soon as this new form was completed and tried, a gain of one half a horse-power was at once realized, and by the addition of a few more feet of battery surface, the power was found to be above four horse. Further addition of battery would still augment the power, and I see no reason why ten horse-power might not be obtained from this engine, by the addition of more battery; but whether it would be economical to increase power by this means alone, and to ascertain the point, for this and every other engine, beyond which economy would cease by increasing the battery alone, are matters to be determined by experiment.

"The next important point to be determined was the expense of this power. Much to my own surprise, the expense was found to be less than the most expensive steam-engines, although recently, in Europe, it has been decided by experimenters, and generally conceded, that it was fifty times the cost of the dearest steam-engines; but this is no obstacle to its introduction, considering its immense advantages in other respects. Moreover, if thus much has been done in the very commencement of the undertaking, what may we reasonably expect from its further prosecution? Before it can be rendered available in practice, much remains to be done with the galvanic battery, to render its action regular and durable, and in other ways to establish a certainty of action, so that the engines may be managed by persons not thoroughly skilled in the subjects of electricity and magnetism. It remains also to be proved, whether the power will increase in proportion to the size of the engines. This principle seems to be strongly indicated by past experiments; but yet it cannot be established by calculation or process of reasoning. Experiment upon an extensive scale can alone determine this point. A part of the work preparatory to the building a locomotive engine has been done; but it seems necessary to try further experiments before incurring the expense of another large engine upon the plan above mentioned. The rotary form of the engine has not been tested, although it possesses advantages not to be found in any form of the reciprocating engine. There are some obvious disadvantages attending its construction; but it is hoped that they will be outweighed, more especially as this form of the engine will occupy less than one half of the room required for the reciprocating form.

"It would seem very desirable that the investigation thus begun,

and so far successfully conducted, should be carried at least beyond *an uncertain issue*, and every important point should be settled, and particularly that of its availability on an extensive scale. The power is peculiarly fitted for purposes of navigation, if it can be made subervient; and a trial upon a scale of one hundred horse-power seems to be the only mode of arriving at a definite conclusion upon this point. It is obvious that, preliminary to such an undertaking, a great many experiments will be absolutely necessary; and such only as one quite familiar with the difficulties of entering upon an entirely new field of operation can properly appreciate."

At the exhibition before the Smithsonian Institution, the engine was operated by a battery contained within a space of three cubic feet, the engine and battery weighing about one ton. When the power was thrown on by motion of a lever, the engine started off magnificently, making one hundred and fourteen strokes per minute; though when it drove a circular saw ten inches in diameter, sawing up boards an inch and a quarter thick into laths, the engine made but about eighty strokes per minute.

The force operating upon the magnetic cylinder throughout the whole motion of two feet was stated by Prof. Page to be six hundred pounds when the engine was moving very slowly, but he had not been able to ascertain what the force was when the engine was running at a working speed, though it was considerably less.

At the American Association, Prof. Page estimated that the cost of one horse-power for twenty-four hours would be about 20 cents; that is, provided the principle can be made to work for so long a period as twenty-four hours uninterruptedly. He had succeeded in operating a machine of four horse-power three hours, but was as yet dubious of the continued power of the battery, which is liable to attain its maximum at about this period, and then decrease in a similar ratio. Prof. Johnson observed that this estimate was based upon too high a cost for the zinc, and that 10 cents would be a nearer estimate. In either case, a very great advance is made upon all previous experiments. It was also observed, that the cost of electro-magnetic power was not to be reckoned in this comparison by the mere cost of zinc, nor the cost of steam by the pounds of coal consumed. The cost of human life, the sacrifice of millions of property, and the risk of millions more, and all the contingent advantages and disadvantages, were to be taken into account. Prof. Page explains his mode of measuring the power of the engine as follows:—The brake was loaded to 620 pounds; the power required to barely keep the engine in motion under this load was 126 pounds. The full power being on, the engine made eighty revolutions per minute under this load. The circumference of the wheel being about four feet, it was easy for any one to compute the horse-power from these data.

The method pursued by Prof. Page is said to be entirely new and distinct from any hitherto tried. In all former electro-magnetic machines, the power is made up of a series of impulses, while in Page's engine, which he styles an axial engine, the power is uniform and continuous, and it is as easy to make an engine of twenty-four feet

stroke as one of two feet, like that already constructed and exhibited. Prof. Page expects to make a trial upon a railroad soon, and hopes to see the project of an engine and magnetic boat (not *steamboat*) of one hundred horse-power carried out.

As an evidence of the great power derived from electro-magnetism, the following experiment was made at the Smithsonian Institution. An iron bar, weighing one hundred and sixty pounds, was made to spring up by magnetic action, and move rapidly through the coils up and down, dancing like a feather in the air, without any visible support. The force operating on this bar was stated to average three hundred pounds through ten inches of its motion, and could be applied to raise the bar one hundred feet quite as readily as through ten inches.

ON THE APPLICATION OF ELECTRO-MAGNETISM AS A MOTIVE POWER.

THE following abstract of a paper read before the London Society of Arts, by Robert Hunt, Esq., commends itself to the attention of those interested in the application of electro-magnetism for practical purposes.

The author, after noticing the numerous and ingenious attempts which have been made to apply electro-magnetism as a power for moving machines, states, that, notwithstanding the talent which has been devoted to this interesting subject, and the large amount of money which has been spent in the construction of machines, there does not exist an electro-magnetic machine capable of exerting power economically. Finding that, notwithstanding the aid given to Jacobi by the Russian government, that able experimentalist has abandoned the subject, the author has been induced to devote much attention to the examination of the first principles by which the power is regulated, with the hope of being able to settle the entire question on a satisfactory basis. The power of electro-magnets, it is believed, may be increased without limitation. A voltaic current produced by the chemical disturbance of the elements of any battery, no matter what its form may be, is capable of producing by induction a magnetic force, *this force being always in an exact ratio to the amount of matter (zinc, iron, or otherwise) consumed in the battery.* The greatest amount of this magnetic power is produced when the chemical action is the most rapid. Hence, in all magnetic machines, it is more economical to employ a battery in intense action than one in which the chemical action is slow. It has been most satisfactorily proved that a one horse-power is obtainable in an electro-magnetic engine, the most favorably constructed to prevent loss of power, at the cost of 45 pounds of zinc, in a Grove's battery, in twenty-four hours; while 75 pounds of zinc are consumed in the same time to produce the same power in a battery of Daniell's construction. The cause of this was referred to the necessity of producing a high degree of excitement to overcome the resistance which the molecular forces offer to the electrical perturbations, on which magnetic force depends. It was contended, that although we

may not have arrived at the best form of voltaic battery, yet that we had learned sufficiently of the law of electro-magnetic forces to declare that, under any conditions, the amount of magnetic power would depend on the change of state, consumption of an element, in the battery, and that the question resolved itself into this: — What amount of magnetic power can be obtained from an equivalent of any material consumed? The following were regarded as the most satisfactory results yet obtained: — 1. The force of the voltaic current being equal to 678, the number of grains of zinc destroyed per hour was 151, which raised 9,000 pounds one foot high in that time. 2. The force of current being, relatively, 1,300, the zinc destroyed in an hour was 291 grains, which raised 10,030 pounds through the space of one foot. 3. The force being 1,000, the zinc consumed was 223 grains; the weight lifted one foot 12,672 pounds. One grain of coal consumed in the furnace of a Cornish engine lifted 143 pounds one foot high, whereas one grain of zinc consumed in the battery lifted only 80 pounds. The cost of one hundred-weight of coal is under 9*d.*; the cost of one hundred-weight of zinc is above 216*d.* Therefore, under the most perfect conditions, magnetic power must be nearly twenty-five times more expensive than steam-power. But it is an impossibility to reach even this, owing, in the first place, to the rate with which the force diminishes through space. As the mean of a great many experiments on a great variety of magnets, of different forms and modes of construction, the following result was given: — Magnet and armature in contact, lifting force 220 lbs.; magnet and armature distant one 250th of an inch, 90.6 lbs.; distant one 125th of an inch, 50.7 lbs.; distant one 63d of an inch, 50.1 lbs.; distant one 50th of an inch, 40.5 lbs. Thus, at one 50th of an inch distance, four fifths of the power is lost. This great reduction of power takes place when the magnets are stationary, but a greater reduction of original power is occasioned when they are set in motion. Indeed, any disturbance produced near the poles of a magnet diminished its attractive force during the continuance of the motion. The attractive force of a magnet being 150 pounds when free of disturbance, it fell to one half by causing an armature to revolve near its poles. Therefore, when a system of magnets constructed to produce a given power is set in revolution, every magnet at once suffers an immense loss of power, and consequently their combined action falls in practice very far short of their estimated power; this fact has been before distinctly stated. And not merely does each magnet thus sustain an actual loss of power, but the power thus lost is converted into a new form of force, or rather becomes a current of electricity, acting in opposition to the primary current by which the magnetism is induced. From an examination of all these results, Mr. Hunt is disposed to regard electro-magnetic power as impracticable, on account of its cost, which must necessarily be, he conceives, under the best conditions, fifty times more expensive than steam-power, and is at present at least one hundred and fifty times as expensive. — *London Athenæum, June.*

APPLICATION OF ELECTRICITY AND HEAT AS MOTIVE POWERS

AT the meeting of the British Association, Mr. Petrie stated, as the result of careful experiments, that a voltaic current of one unit in quantity (or that from one grain of zinc electro-oxidized per minute), and of 100 degrees intensity, represents a dynamic force of $302\frac{1}{2}$ pounds raised one foot high per minute. From this we can infer an important fact, that one horse-power is the theoretic or absolute dynamic force possessed by a current of electricity derived from the consumption of one and fifty-six hundredth pounds of zinc per hour in a Daniell's battery. But the best electro-magnetic engine that we can hope to see constructed cannot be expected to give more than half or a fourth of this power; in any case, we see here the limit of power, which no perfection of apparatus can make it exceed. Some of the best electro-magnetic engines ever invented, which have been tested by Mr. Petrie and others on a practically useful scale, have only given a power at the rate of fifty to sixty pounds of zinc per horse-power per hour. The smallness of this power in comparison with the absolute value of the current (1.56 pounds zinc per horse-power per hour) should not occasion surprise, if we consider the present state of steam after many years of improvement. According to the determinations of Joule and Rankine on heat, one pound of water raised 1° of temperature is equivalent to 700 pounds weight raised one foot. But the best Cornish engines only yield one fourteenth of the power that the combustion of the carbon actually represents, and many locomotives only one hundredth part, showing what great rewards may yet await the exercise of inventive genius in this department, and that we need not wonder that we have as yet only obtained one thirty-second part of the power possessed by electricity. There is, however, a far greater likelihood of obtaining a larger proportion of the real power from electricity than from heat, owing to the character of the two agents. If carbon could be burnt or oxidized by the air, directly or indirectly, so as to produce electricity instead of heat, one pound of it would go as far as nine pounds and one third of zinc (in a Daniell's battery), chiefly because there are as many atoms in one pound of carbon as there are in five pounds and a quarter of zinc, and partly because the affinity (for oxygen) of each atom of (incandescent) carbon is greater than that of an atom of (cold) zinc, minus the affinity of the hydrogen for the oxygen in the water of the battery.

The peculiar mode in which the electric current produces dynamic effects has led to much miscalculation respecting the power obtainable from it. In any sort of an electric engine, the material to which the neighbouring current gives motion, whether it be another movable current, or, what is more usual, a magnetic body, is impelled in one direction with a constant force, and this force, whether it be attraction, repulsion, or deflection, is, like the power of gravity, sensibly constant at all velocities, provided only the same quantity per minute of electric current be maintained. This is quite different in steam-power, in which the faster the piston moves, the greater is the volume of steam per minute that must be supplied to move it, or else the less

will be the power with which it moves. This fact, then, that the force with which an electric current of a given quantity acts is the same at any velocity of motion, bears no analogy to the case of steam, but would indicate that the dynamic result obtainable from a given electric current might be infinitely great, and so it would be, were it not that the part moved always tends to induce a current in the wire in a reversed direction; and this inducing influence, which increases with the velocity of motion, conflicts with the original current and reduces its quantity, and consequently the power of the motion and the consumption of materials in the battery. Some have imagined that possible alterations in the machine, or in its mode of action, would avoid the evil, or even cause the indirect current to flow with the primary current instead of against it. The impossibility of this, though not readily proved in detail, can be so at once by reference to general principles. If true, it would be a creation of dynamic force, or the evolving of an unlimited force from a limited one. The tendency to an opposing induced current in the primary wire is involved in the very principle of the system, so that no ingenuity can ever get rid of the retarding influence of the induced action. The only way to overcome its power, so as to prevent the primary current from falling below a given rate or quantity, when the machine is allowed to attain rapid motion, is to increase the electro-motive power of the battery, the intensity (not the quantity) of the current, so that it shall be less affected by the opposing induction. From a want of a clear apprehension of these principles, inventors have misapprehended the direction in which improvements were to be made, and much ingenuity and means have been thus wasted.

IMPROVEMENTS IN BATTERIES.

PROF. H. REINSCH describes a new voltaic battery of considerable power without the use of any exciting metal. A common porous cell is filled with powdered coke, into which is fixed a rod of coke for conducting the current. This porous cell is placed in a jar or glass, which is then filled with coarse bruised coke, to which is also connected a rod of the same material. The coke in the inner cell is moistened with nitric acid, that in the external one with a saturated solution of common salt. Conducting wires being attached to the coke cylinders, a tolerably strong current is indicated. A small electro-magnet has thus been made to sustain half a pound, but a large one was not affected. The spark and shock have been very decidedly obtained from a single compound cell. — *London Athenæum, July.*

Carbon from Gas Retorts as the Negative Plate of the Battery. — At the meeting of the Royal Society on March 7, a paper was read by C. L. Dresser, Esq., on "the application of carbon deposited in gas retorts as the negative plate in the nitric-acid voltaic battery." In retorts used for the destructive distillation of coal to obtain the carburetted hydrogen gas, after a certain time, a deposition of carbonaceous matter takes place, which finally becomes so thick as to fill up a portion of the retort with solid substance, and to line the whole with

a coating varying from the thickness of paper to several inches. It occurs in several forms, but one of great hardness, very little if at all porous, and of a stony feature, the author found best adapted for the negative conductor of his nitric-acid battery. The most convenient form is the prismatic, $1\frac{1}{2}$ inch square on the side and about 7 inches long, which is immersed 4 inches in the acid, and used with round, porous cells, the zinc cylinder being 3 inches in diameter and $4\frac{1}{2}$ inches high. The carbon is cut into thin plates or prisms at an expense of about $1\frac{1}{2}d.$ each, and prisms may be obtained 18 inches long. The only precautions necessary in using this form of carbon are, after using the plates, to immerse them for a few moments in boiling water, to take off the adhering acid, and then dry them. The same plates and prisms have been used for months without any deterioration of their conducting power, or any decomposition or alteration. There is little difference between the action of these plates and those of platinum, the carbon being perhaps a little the superior. A battery of 100 plates of carbon costs under £4, while one of platinum, of equal power, costs £60 or £70. — *Proceedings of the Royal Society, March 7.*

APPLICATION OF THE GALVANIC LIGHT.

SEVERAL interesting experiments have recently been performed at St. Petersburg, showing the application of galvanism to lighting the streets. The first experiment on a large scale came off Dec. 8, 1849. The three principal streets of the city, which radiate in a straight line from the Admiralty tower, were lighted from 7 to 10 o'clock in the evening. The light was placed in the central gallery of the tower, about the height of a four-story house, and was so bright that the eye could scarcely endure it for a second. Although the night was perfectly clear, and the stars shining, the rays could be seen sideways as they emanated from the light, like the rays of the sun through a small hole in a dark room. The corner houses, to the distance of three or four hundred paces from the tower, were so illuminated that you could see a fly. The gas-lights looked red and smoky, while the electric light was dazzlingly white. Seen from the street, the luminary looked about six inches in diameter, and, at a distance, appeared like a fire-ball, thrown from a bomb and floating in the air. The light often changed its color, and by turns became red, blue, and yellow, which made it more tolerable to the eye. Sometimes it would vanish for a moment and reappear with brilliancy. In spite of the gas-light, the shadow of the electric light could be clearly distinguished at the distance of about 500 paces, but farther off the gas gained the precedence. The battery which delivered the stream is a charcoal battery of 185 pieces, each of which is one and a half square feet in surface; the zinc cylinders are fifteen inches high, ten inches in diameter, and with at least a third of an inch thickness of metal. A white cylindrical vessel, of a size to correspond, stands within the cylinder, and serves as a support to the coal which surrounds it. As there was no room in the vicinity of the tower for the erection of this

monstrous battery, it is put up in two large halls of the rear building. It is kept heated day and night, the heat and steam of the acids thus becoming intolerable. From the rear building wires are carried over insulated posts, as in the telegraph, and run up the outside of the tower, whence they come in contact with the coal-points, which are square rods one quarter of an inch thick and five inches long, inclosed in brass boxes, and regulated as to their distance from each other by screws. The coal burns to the length of about half an inch; beyond this glowing point a large lens is placed, which greatly increases the light. The change of color is caused by the burning of the coal when the two poles do not touch, the light appearing blue, or yellow, or red, according as the distance between them is greater or less. At the negative pole the coal burns rapidly, and must be renewed almost every half-hour; this interrupts the light, and is, in fact, the worst feature in the whole experiment. A more complete apparatus is now in course of erection, in which the coals burn *in vacuo*, and are regulated by clock-work instead of by the hands. An enormous lantern is also placed on the tower. The same galvanic light has been applied at Dresden, to imitate the rising of the sun in the representation of Meyerbeer's *Prophet*. The disk of the sun is formed by a parabolic concave mirror of about one foot in diameter, the coal-points burning in the focus. On account of the dazzling brilliancy of the light thus produced, it appears to be more suitable for such uses than for illuminating the streets. — *New York Tribune* April 10.

VOLTAIC ARC.

In a paper presented to the French Academy on Feb. 23, M. Matteucci communicates some results to which his experiments upon the voltaic arc have led him. They are the following. 1. The temperature of the positive pole is always greater than that of the negative, and the difference is greater as the conducting power of the metal used is less. The voltaic arc can only be formed when the poles have been brought in contact and then separated, because in this way, in proportion as they are separated, the conducting power of the circuit becomes less at the point of contact, and consequently the heat of the extremities increases, whence results the disaggregation of their parts. 2. The voltaic arc, which is formed of matter detached from the poles, often in a state of combustion, has a conducting power differing with the different metals; this power is not proportional to that of the metal of the poles, but rather varies with the quantity of the metal which disappears in the experiment, and as this quantity is greater with bad than with good conductors, it follows that the conducting power of the voltaic arc is greater with the former than with the latter. This power is greater than would be at first supposed. Thus, in an entirely metallic circuit we obtain in 60 seconds, and in the voltametre, 46 cubic centimetres of gaseous mixture, while we obtain in the same time quantities of the same mixture, expressed by the following numbers, varying with the metal used, there always being

in the circuit a luminous arc 3 millimetres long : copper, 23 cubic centimetres, brass 26, iron 27, coke 29, zinc 35, tin 45. 3. The difference in weight in the two poles, after experimenting, varies chiefly with the elevation of temperature, other circumstances being equal. With coke and iron, it is always the positive pole which has diminished the most in weight, but with all the other metals it is the negative. With coke and iron the positive point is found corroded, with the others the negative. With poles of brass it is found that the positive pole always increases in weight. 4. The elevation of the temperature of the poles, the conducting power of the arc, and the quantity of matter destroyed, are greater in common air than in rarefied air or in hydrogen gas. The quantity of matter disappearing in the production of the voltaic arc varies with the position of the arc relative to the magnetic meridian, being greater when the arc is perpendicular to the meridian than when it is in the same plane. It is shown that the matter detached from the two poles passes from the one to the other. The voltaic arc, like the electric spark, decomposes gases through which it is transmitted.

M. Despretz, in a paper presented to the French Academy on April 1, gives the following as the results of experiments upon the voltaic arc. 1. The length of the arc increases more rapidly than in proportion to the number of elements in the battery, when it is placed end to end, and the increase is more rapid for small than for large arcs. Thus the arc produced by 100 elements is almost quadruple that given by 50 elements. 2. If the battery is so arranged as to unite the similar poles, that is, "quantitatively," the length of the arc does not increase in proportion to the number of elements. Thus the arc of 100 elements being 25.2 millimetres, it is only 69.2 mil. for 600 elements arranged in six parallel series, although when placed end to end they give an arc of 183.5 mil. 3. If the positive pole is below, the arc is not so long as when it is above. 4. In a plane perpendicular to the magnetic meridian, the arc is larger when the positive pole is towards the east than when it is towards the west.

ON THE CAUSE OF THE AURORA BOREALIS.

"WITH regard to the origin of the aurora borealis, it seems natural to attribute it to the electric fluid contained in the atmosphere, which at great heights, where the air is rarefied, must become luminous, as under the receiver of an air-pump, and in the barometer vacuum; this hypothesis would acquire a great probability if we succeeded in proving by direct experiments that magnetism exerts an influence upon electric light."

This extract from a memoir by Morlet on the aurora borealis induced M. de la Rive to communicate to the Paris Academy the following experiment, showing the influence of magnetism on the light produced by ordinary electrical discharges. "I introduce into a glass globe, by one of the two tubulures with which it is furnished, a cylindrical iron bar, of such length that one of its extremities reaches nearly to the centre of the globe, while the other extends a short distance

out of the tubulure. The bar is hermetically sealed in the tubulure, and covered throughout its length, except at its two ends, with an isolating and thick layer of wax. A copper ring surrounds the bar above the isolating surface in its internal part the nearest to the side of the globe; from this ring proceeds a conducting rod, which, carefully isolated, traverses the same tubulure as the iron bar, but without communicating with it, and terminates externally in a knob. When, by means of a stopcock adjusted to the second tubulure of the globe, the air in it is rarefied, the knob is made to communicate with one of the conductors of an electric machine, and the external extremity of the iron bar with the other, so that the two electricities unite in the interior of the globe, forming between the internal extremity of the iron bar and the copper ring which is at its base a more or less regular fascicle of light. But if the external extremity of the iron bar is placed in contact with one of the poles of a strong electro-magnet, taking good care to preserve the isolation, the electric light takes a very different aspect. Instead of issuing, as before, from the different points of the surface of the terminal part of the iron bar, it is emitted only from the points which form the contour of this part, so as to constitute a continuous luminous ring. This is not all; this ring and the luminous jets which emanate from it have a continuous movement of rotation around the magnetized bar, now in one direction, now in another, according to the electric discharges and the direction of the magnetization. Lastly, more brilliant jets appear to issue from this luminous circumference, without being confounded with those which terminate on the ring and from the fascicle. As soon as the magnetization ceases, the luminous phenomena becomes again what it was previously, and what it is generally in the experiment known as the *electrical egg*.

This experiment appears to account very satisfactorily for what passes in the phenomena of the aurora borealis; in fact, the light which results from the union of the two electricities in the part of the atmosphere which covers the polar regions, instead of remaining vaguely distributed, is carried by the action of the terrestrial magnetism round the magnetic pole of the globe, whence it seems to rise in a revolving column, of which it is the base. We thus understand why the magnetic pole is always the apparent centre whence issues the light constituting the aurora borealis, or towards which it appears to converge. — *Silliman's Journal*, May, 1850.

LAWS AND ORIGIN OF THE AURORA BOREALIS.

PROFESSOR OLMSTED presented to the American Association, at New Haven, a paper on the aurora borealis, in which he endeavoured to show that we have just passed through an extraordinary period of auroras, which he called a "visitation," which commenced in 1827, and closed in 1848. He then proceeded to lay down the laws of the phenomenon, as deduced from a large number of facts. They are as follows: —

1. That the aurora of the first class usually *commences* near the end

of evening twilight, in the form of a northern light, resembling the dawn; that it usually arrives at its *maximum* at all places, however differing in longitude, at the same part of the night, namely, from ten to eleven o'clock, but more frequently a little before eleven; and that auroras of the highest order frequently continue all night, while those of an ordinary character commonly end before midnight. 2. That a great aurora is usually preceded by a large *bank or cloud of a peculiar vapor*, differing in its nature from ordinary clouds, commonly exhibiting a milky appearance, but sometimes of a smoky hue, or the two mixed together; and that the extent and density of this auroral vapor, resting upon the northern horizon, form the best prognostic we have of the probable intensity of the exhibition which is to follow, comprising the material of which the successive forms of the aurora are constituted. 3. That the auroral *waves*, when peculiarly grand, make their appearance later than the streams and arches, and usually later than the corona, continue to a later hour of the night, appear at a lower level than the streamers, and roll upwards, in the direction of the streamers, toward the point of general concourse. 4. That auroral exhibitions of the higher order are commonly of *great extent*, spreading over no inconsiderable part of the earth's surface, and reaching to a great but variable height. 5. The auroras of the first class have three distinct forms of periodicity;—a *diurnal* periodicity, commencing, arriving at the maximum, and ending, at different hours of the night, as already asserted; an *annual* periodicity, rarely or never occurring in June, and the greatest number of the highest order clustering about November, these last bearing a striking resemblance to each other; and a *secular* periodicity, the most remarkable of all, recurring in great series, which we have denominated “auroral visitations.” That the visitations most marked and best defined occur at intervals of about sixty-five years, recurring from the middle of one period to the middle of the next period, and last from twenty to twenty-two years, making the interval from the end of one to the beginning of the next about forty-five years. 6. That, while the forms of the aurora usually appear to be under the control of *magnetic forces*, yet this is not always the case, since the arches do not always culminate in the magnetic meridian, nor do they always place themselves at right angles to that meridian, nor does the effect on the needle correspond to the different states of intensity of the aurora. 7. That the aurora has remarkable *geographical* relations, belonging chiefly to the higher latitudes, and only in the great visitations descending below the latitude of 40° ; but descending lower on the western than on the eastern continent, and prevailing more in the northern than in the southern hemisphere.

Professor Olmsted then gave his reasons for thinking that the aurora is not produced by electricity or by magnetism, though it apparently has some relation to the latter in the forms and positions of its arches, and in other respects, after which he stated his grounds for seeking for the explanation of the phenomena in the planetary spaces, and argued in favor of its cosmical origin; first, from the *extent* of the exhibitions, which is greater than could arise from any terrestrial causes.

nations or atmospheric precipitations. Secondly, from the *velocity* of the motions, which are too great for any terrestrial forces. Thirdly, from the occurrence of the different stages of an aurora (the beginning, maximum, and end) at the *same hour* of the night, in places differing widely in *longitude*, which indicates that successive portions of the earth, in the diurnal rotation, come under the origin of the aurora situated in space. Finally, from the *periodicity* of the exhibitions; — the diurnal, which shows a relation to the position of the sun with respect to its position; the annual, which indicates a relation of the auroral body to the earth's orbit; and especially the secular, which implies a cycle, at the end of which the auroral body and the earth return to the same relative position in the heavens, while the very existence of such a secular periodicity takes the phenomenon out of the pale of terrestrial, and places it within the pale of astronomical causes. This theory also infers that the auroral body (whence the material of the aurora is derived) is a nebulous body of light, semi-transparent, inflammable and magnetic matter, revolving around the sun; and that probably there are many such collections of nebulous matter diffused through the planetary spaces. It may be remarked that there is, according to these views, a great analogy in the origin of the aurora borealis and of the meteoric showers.

EFFECTS OF ATMOSPHERIC ELECTRICITY UPON THE WIRES OF THE MAGNETIC TELEGRAPH.

THE *Revue Scientifique* for December, 1849, contains an interesting article by Mr. Baumgartner on the above subject. The following are some of his results. 1. The needle rarely coincides with the point which is determined by its astatic state and the tension of its suspension thread; this shows it to be influenced by an electric current. 2. The variations are of two kinds; there are some which reach 50° , others extend over $\frac{1}{2}^{\circ}$ or $8'$. The first are less frequent, and they differ so often in direction and intensity that it is impossible to deduce a law for them. The small deviations appear connected by a very simple law. The observations made at Vienna and at Gratz appear to show that, during the day, the electric currents move from Vienna and from Gratz to Semmering, which is more elevated. This direction is inverse during the night. The changes occur after the rising and setting of the sun. 3. The regular current is less disturbed by the irregular one when the air is dry and the sky serene, than when the weather is rainy. 4. In general, the current is more intense with short than with very long conductors; often, even, the current of the longer chain is opposed to that of the shorter one. Where there is a difference of intensity it is far greater than that which could originate from the resistance of the longer conductor. When the sky is cloudy and the weather stormy, there are frequently observed in the electric conductor currents sufficiently intense to affect the telegraphic indicators, which are, however, far from having extreme sensitiveness. In placing the conducting wires of the northern telegraph line from Vienna, the workmen frequently felt a kind of spasm in handling the wires,

which ceased, however, when they took the precaution not to touch the wires with naked hands. These spasms were most frequent and intense in the highest region of the line. The action of atmospheric electricity on the telegraphs is stronger on the approach of a storm.

ATMOSPHERIC ELECTRICITY.

THE council of the British Association, in their report, observe, that among the results obtained by the observations upon atmospheric electricity at Kew, are these. During the twenty-four hours, the electrical tension of the atmosphere acquires two *maxima*, about 1 A. M. and 10 P. M., and suffers two *minima*, about 4 A. M. and 4 P. M., these being also nearly the hours of barometrical *maxima* and *minima*. In the course of the twelve months there is distinctly a periodicity of electrical tension; the maximum for the year being in the depth of winter, and the minimum in the height of summer.—*London Athenæum*, August.

In the course of a paper on the "electricity of the air," Mr. Faraday states the following as the results obtained by M. Quetelet, of Brussels, from observations on atmospheric electricity. 1. Its quantity increases directly with the distance from the earth's surface. 2. The electricity is greatest in the coldest months. 3. It is greatest at 8 o'clock A. M., and 9 P. M. 4. It is always greatest when the sky is clear. 5. The electricity of fog or snow is double that of rain, and equal to the mean maximum of the cold months. 6. During five years but twenty-five instances of the atmosphere being in the negative state have been noticed, and these were either directly before or after rain or a storm. 7. The electricity is greatest in quantity when the wind is from S. E. to E. S. E. and from W. N. W. to N. W.; the interposed minima were at W. S. W. to W., and at N. to N. N. W.

IMPROVEMENTS IN TELEGRAPHS.

FROM the large number of improved telegraphs produced during the past year we have selected the following, as apparently the most worthy of notice.

Electro-chemical Telegraph.—Messrs. Westbrook and Rogers, of Baltimore, have received a patent for an improvement in electro-chemical telegraphs, the claim for which is as follows:—"What we claim is, recording telegraphic signs on the surface of a revolving metallic cylinder, plate, or other equivalent surface, by means of an acidulated liquid, or saline solution, or water, held between the point of the wire conductor and the metallic surface, by means of a non-conducting porous substance, contained in a glass or other non-conducting reservoir, in which the recording fluid is contained, to which the electric current from a battery is applied by means of any of the known forms of manipulators and anvils used for making and breaking the circuit; the recording fluid being applied to the metallic recording surface, substantially in the manner herein set forth, by which the use of every description of paper is dispensed with, thereby saving great expense in

telegraphing." It is stated that the expense for the recording fluid will be less than one cent per day. — *Washington Republic*.

Electro-thermic telegraph. — Mr. W. S. Thomas, of Norwich, N. Y., has patented a new telegraph, which is an application of heat as a substitute for electricity in recording telegraphic communications. Heat, generated by the electricity passing over the wires, is used for making and recording the letters of the alphabet. The electricity, after it reaches the recording instrument, is conducted on to an attenuated platinum point, in contact with the paper, which becomes instantly heated, or as suddenly cold, as the circuit is made or broken, and thus the necessary mark is made. Common dry paper may be used, but that chemically prepared is better. — *Farmer and Mechanic*, Feb. 21.

The *London Builder* for April describes a new telegraph, invented by Mr. A. Mitchell, for transmitting messages and news by means of one wire. Like House's telegraph, it is worked with keys after the manner of a piano-forte, the only difference apparently being, that, instead of printing the letters, a finger is made to point to them on a dial on which they are arranged in order.

Henley's Magneto-electric Telegraph. — An experiment has just been made, under the direction of the French government, to test the efficacy of Mr. Henley's magneto-electric telegraph, which is worked without batteries of any kind, and at a fraction of the cost of the voltaic system. The line of railway assumed for the trial was that from Paris to Valenciennes. The persons present at the two stations were the director of the French telegraph, a commissioner appointed by the Belgian government, and a few others. The distance is 180 miles, being the longest telegraph line in France. After a most satisfactory series of trials on the single distance, first with full power, and afterwards with one twentieth of the power, the wires were connected so as to treble the total length of wire, making 540 miles to and from Paris and back, the magnetic message being communicated through the first wire, back by the second, through the third, and back again by the earth. It was not anticipated that the magnet could possibly work through this resistance; but, in fact, it is alleged it was worked as distinctly and rapidly as when only made to traverse the 180 miles with full power. The ordinary telegraph, with battery power, used by the French government, was then put in requisition; but not the slightest effect was produced. On the single distance even, a signal was sometimes not obtained for several minutes, owing, it is said, to some fault in the batteries. The government officers and others inspected the working operations, and expressed themselves thoroughly satisfied with the success of the trial. — *London Mining Journal*.

Telegraphic Manipulator. — Mr. Edward Everett, of Illinois, has invented a "telegraphic manipulator," which may be used either with Morse's or Bains's method of communication, as it impresses on paper, by a neat and simple mechanism, the dots and marks, which, by both these methods, constitute the telegraphic alphabet. The process of writing by this alphabet has hitherto been the work of great skill, requiring long practice before the art can be acquired, and great mental effort for giving to each dot, line, and intervening space its proper

length. By this machine, the dot, line, or combination of dots and lines, representing each letter of the alphabet, is produced by an almost instantaneous action of the electric fluid, proceeding from the touch of an appropriate key, marked with the letter to be represented. There are two rows of keys, similar to those of a piano-forte, sufficient in number to represent each of the letters of the alphabet, and each of the ten numerals. The keys, marked with the letters which they represent, are arranged in a convenient order for the most rapid use, on a principle similar to that by which types are distributed in a printer's case. The instrument, when in operation, is kept in motion by clock-work. A single touch of a key produces all the dots and lines which represent the appropriate letter. This is done with a speed limited only by the capacity of the recording instrument at the other end of the line to receive the impressions. The dots and marks representing each letter, as formed by the machine, are always of uniform dimensions, and separated by spaces of uniform length, and the machine is so simple in its construction as not to be liable to get out of order.

SIEMENS'S TELEGRAPHIC APPARATUS.

A REPORT presented to the French Academy states that M. Siemens has effected an improvement in the arrangement of alphabetic telegraphs, by means of which the party receiving the message can, at the same time, communicate with the other party without having recourse to a second wire, or in any way disturbing the arrangement of the apparatus or interrupting the delivery of the message. The armature of the electro-magnet is provided with a lever, about an inch long, which produces two very different actions. The effect of the first is, at every double vibration (backwards and forwards), to drive forward the wheel, which is mounted upon the shaft of the needle or indicator, the distance of one tooth, and consequently the needle is carried forward a letter. By the second action, it breaks the circuit and stops the current from which it has itself received its motion, but not until it is itself stopped in its forward motion, i. e. when the armature, attracted by the electro-magnet, has approached as near the poles as possible; the circuit being then broken, the armature ceases to be attracted, and being at once drawn back by its spring, the lever returns to its former position, the circuit is again completed, and the operation is renewed. These isochronal vibrations would continue as long as the battery furnished a current of equal intensity. The needle could thus be made to move as fast as the eye can read, but its motion would be a series of jerks, so that nothing could be distinguished. To remedy this, there is a contrivance by which the needle may be stopped for a fraction of a second, so that it will distinctly point out the letter to which attention is to be directed. This is done by having around the dial as many stops as there are signs, and upon each stop its sign is marked. On pressing the finger upon any one of them, a small vertical rod is depressed so as to act as a stop to a horizontal lever parallel to the needle and mounted on its axis, which amounts to the same thing as if the needle itself were stopped. In sending a message, the finger is to be

pressed successively upon the stops corresponding to the signs to be transmitted, and when the needle comes round to that sign it will stop. The needle at the other station will also stop, but not at precisely the same instant. If the person there is in doubt as to the sign intended he has only to place his finger on a stop to arrest the needle at the other station. "It will be understood that by this apparatus the communication will assume the nature of a verbal conversation, in which each party can put in his word."

But instead of resting here, and relying entirely on the correctness of the party receiving the message, M. Siemens has arranged a magnetic printing apparatus, by means of which the message may be as well printed as by a press. This apparatus consists of a vertical shaft similar to the shaft carrying the needle, and receiving rotary motion by means of similar mechanism, which carries at its upper part thirty horizontal radiating arms, set in the same plane at equal distances apart, on the end of each of which arms is a letter in relief. These arms are flexible, and as they act like springs, it is sufficient to drive them upwards against the fillet of paper a little above them, and make them press against it with sufficient force. This paper passes round about half the circumference of a printing roller provided with printing ink, which is only communicated to the paper where the types on the arms strike. By a peculiar arrangement, the printing roller, which is stationary at the moment of printing, is made to turn and carry the paper round a suitable distance for the purpose of producing a blank space as soon as it has received a letter, and a larger space when a word is completed. The hammer which strikes the letter underneath is so contrived as to do it at the precise moment when this letter stops to receive the blow.

This is but a mere sketch of the report. In concluding, the committee say that this system, worked with care, "appears to possess incontestable superiority over all other apparatus of the like nature, and that with regard to speed they are led to believe that it surpasses all other alphabetical apparatus."

SUBMARINE TELEGRAPH BETWEEN ENGLAND AND FRANCE.

THE project of constructing a submarine telegraph between England and France, across the Straits of Dover, first announced during the year 1849,* has been in part accomplished. The following description of the laying down the wire, we copy from an English Journal:—

At one o'clock the steamer *Goliah* was ready to start across the Channel, with all the necessary apparatus on board, and a crew of about thirty men. Between the paddle-wheels, in the centre of the vessel, was a gigantic drum, or wheel, nearly fifteen feet long and seven feet in diameter, weighing seven tons, and fixed on a strong framework. Upon it was coiled up, in careful, close convolutions, about thirty miles of telegraphic wire, one tenth of an inch in diameter, incased in a covering of gutta-percha the thickness of the little

* See *Annual of Scientific Discovery*, 1850, p. 128.

finger. The point proposed to be reached, Cape Grinez, the nearest landmark to the English coast, and between Calais and Boulogne, is a distance of twenty-one miles, so that a surplus supply of nine miles of wire was held in reserve for the purpose of slackening. The connecting wires were placed in readiness at the Government pier in the harbour, and likewise at the Cape, where they run up the face of the acclivity, which is 194 feet above the sea-mark.

Some interesting experiments were first made upon a small scale to show the practicability of the plan. A mile of wire was paid out off the deck, from the pier to Shakspeare's Cliff, and the sinking process was proved to be a practicable performance. A communication was also sent through twenty-four miles of wire. On Wednesday morning the experiment of sinking submerinely was practically commenced. The *Goliah* put out to the pier, with her telegraphic tackle and apparatus on board, under a calm sea and sky and a favoring wind. The connection between the thirty miles of telegraphic wire was then made good to 300 yards of the same wire inclosed in a leaden tube on shore, to prevent it being bruised by the shingle on the beach, and to enable the experimenters, as they proceeded out to sea, to send communications on shore. The vessel steamed out at the rate of three or four miles an hour into the open sea, in a direct track for Cape Grinez. The wire weighed five tons and the cylinder two. The operation of paying out the thirty miles of wire commenced on a signal to the sailors to "Go-ahead with the wheel, and pay out the wire," which was continuously streamed out over a roller at the stern of the vessel, the men at every 16th of a mile being busily engaged in riveting on to the wire square leaden clamps, or weights of iron, from 14 lbs. to 24 lbs. in weight, which had the effect of sinking the wire to the bottom, which, on the English coast commences at a depth of 30 feet, and goes on varying from that to 100 and 180 feet, which latter, or 30 fathoms, is the greatest depth.

The whole of the casting out and sinking was accomplished with great precision and success, owing to the favorable state of the day. The only conjectured difficulty on the route was at a point in mid-channel, called the Ridge, between which and another inequality called the Varne, both well known and dreaded by navigators, there is a deep submarine valley, surrounded by shifting sands, the one being seventeen miles in length, and the other twelve, and in their vortex, not unlike the voracious one of the Goodwin Sands, ships encounter danger and lose their anchors, and trolling nets of fishermen are frequently lost. Over this, however, the wire was successfully submerged, below the reach, it is believed, of either ships' anchors, sea-animals, or fishing nets. The remainder of the route, though rougher on approaching the coast of France, was accomplished cleverly, but slowly. A communication, dated Cape Grinez, Coast of France, half past eight, P. M., and received at Dover by submarine telegraph, was as follows:— "The *Goliah* has just arrived in safety, and the complete connection of the under-water wire with that left at Dover this morning is being run up the face of the cliff; complimentary interchanges are passing between France and England, under the strait and through it, for the first time."

Notwithstanding this apparently successful result of the work, the line was cut asunder soon after the connection was completed on the rocks near Cape Grinez, the physical configuration of the French coast being very unfavorable. The precise point where the breakage took place was about two hundred yards out to sea, just where the twenty miles of electric line that had been laid down from Dover joins on to a leaden tube designed to protect it from the surge beating against the beach, and which also serves a similar purpose up the front of the cliff to the station upon the top. The leaden conductor, it would appear, was of too soft a texture to resist the oscillation of the sea, and thereby became detached from the coil of gutta-percha wire that was thought to have been safely incased in it. The occurrence was, of course, quickly detected by the sudden cessation of the series of communications, though it was at first a perplexing point to discover at what precise spot the wire was broken or at fault. This, however, was done by hauling up the line at intervals, a process which disclosed the gratifying fact, that, since its first sinking, it had remained *in situ* at the bottom of the sea, in consequence of the leaden weights or clamps that were strung to it at every sixteenth of a mile. The experiment, as far as it has gone, proves the possibility of the gutta percha wire resisting the action of the salt water, of the fact of its being a perfect waterproof insulator, and that the weights on the wire are sufficient to prevent it being drifted away by the currents, and for sinking it in the sands.

The work at present has been suspended, but will be resumed again during the spring of 1851; a somewhat different plan, however, has been proposed to be followed from that at first adopted. Instead of one slender wire, it is intended to lay down cables inclosing four lines. These cables will be composed of gutta-percha, four or five inches in thickness, the whole incased in wire rope, chemically prepared, to protect it from rot, and kyanized. There will be two of these cables, each twenty miles long, and three miles apart, the whole weight representing 400 tons; and it is expected, when chained down in the bottom of the sea, they will be of sufficient consistency and strength to resist the anchor of a 120-gun ship. The expense of the cables is estimated at £40,000. It is thought that the whole work may be accomplished by May, 1851.

APPLICATION OF THE ELECTRO-CHRONOGRAPH TO THE DETERMINATION OF THE FIGURE AND DENSITY OF THE EARTH, ETC.

At the Charleston meeting of the American Association, Lieutenant Maury, after giving a description of Dr. Locke's electro-chronograph,* remarked that it had occurred to him that, by means of it, the figure and density of the earth, the height of mountains, and differences in the density of the interior strata between the centre and surface of the earth, at different places, might be determined. Professor Keith nad, by means of two globules of mercury to each, converted two other

* See *Annual of Scientific Discovery*, 1850, p. 121.

clocks into electro-chronographs. The index or a pointer to the pendulum passed through a globule of mercury at the lowest part of the arc of each vibration, and while this pointer was in transit through this globule, the circuit was complete, and the recording pen made a dot on the registering surface. The other globule was placed in the upper part of the clock, and so situated that a little metallic pin attached to the axis of the seconds wheel would pass through it at every sixtieth second. As the circuit through this globule was the shorter, the fluid, abandoning the long one through the pendulum, would take the shorter route back, and the pen would thus omit to make a dot at the completion of every minute. If we suppose the mean-time and sidereal clocks each to run with a rate equal to 0s. 0, and their pens each in connection with the register, we shall find that the pen of the latter will make 366 dots while that of the former is making 365 *nearly*, so that if the paper move under the pen at the rate of an inch per second, the distance between the dots of the two pens at a given second will differ from the distance between them the next second the 365th part of an inch nearly. Lieutenant Maury illustrates what he means, and remarks that by a powerful microscope it would be possible to measure with considerable accuracy the 36,500th part of a second. With such refinement in the recording and subdivision of time, if two experimental pendulums, nearly duplicates of each other, were freely suspended and vibrated, the one in New Orleans, and the other near the same meridian on the borders of the great American Lakes, for instance, and if these pendulums were further so arranged as to make and break circuit, so as to record their vibrations in Washington with the standard clock of the Observatory, and if, after these vibrations had been continued till one pendulum had gained a vibration upon the other, the two were made to change places, and vibrated for a like period, we should, theoretically at least, have afforded to us rare facilities for determining an arc of the meridian. If now the two pendulums were placed on the same parallel of latitude, one on the Atlantic and the other in the Mississippi valley, for instance, and vibrated, reversed, and vibrated as before, the data would be complete, theoretically speaking, for determining both figure and density.

By vibrating one pendulum on a mountain and another on the seashore, or at some known elevation above tide-water, we should in the same manner procure the data for determining the difference between the distance of the two stations from the centre of the earth, that is, the height of the mountain. In a similar manner might be determined the differences in the density of the strata interposed between the centre and surface of the earth at different places, and also, from the influence of the moon on the pendulum, we might derive the elements for determining the mass of that planet. This is all true theoretically, but whether it could be done in practice is perhaps doubtful.

Lieutenant Maury also stated that experiments already made encouraged him to hope that the electro-chronographic clock might be used, not only to drive the machinery of the registering apparatus, but to drive the clock-work of the equatorial also.

MEANS OF CAUSING AN ELECTRICAL MACHINE TO WORK IN ALL WEATHERS.

M. MÜNCH states in the *Comptes Rendus* that he has discovered a means of causing an electrical machine to work in all weathers. This means consists in tracing a slight line of tallow on each side of the plate from the centre to the circumference. If this be done in weather when scarcely any thing can be got from the machine, it will be seen, from the first turn of the plate, that every thing is changed, and that it will perform perfectly. If the glass pillars which support the conductor are not covered with a coating of gum-lac, tallow should also be applied lightly to them, and then rubbed off with a dry cloth. It is evident that in these operations the object is to interpose an imperceptible coating of fatty matter between the surface of the glass and the ambient air charged with aqueous vapor.

ELECTRO-DYNAMOMETER.

WEBER has invented a new and very ingenious instrument, which he calls an *electro-dynamometer*. It consists of two coils of fine wire, the smaller of which is suspended within the other by a bifilar suspension, so that their centres coincide and their axes are at right angles. He calls the latter "the multiplier," the other "the bifilar (or rather suspended) coil." They are so connected that the current to be examined, traversing the multiplier, passes by suspending wires through the suspended coil, which turns by their mutual action through an angle, whose tangent measures the intensity of their action. The angle is measured, as in the German magnetometers, by observing with a telescope the reflection of a scale placed at a considerable distance in the mirror, carried by the bifilar coil. The action between the coils is as the square of the intensity of the current, while that exerted on the needle of a rheometer is simply as the intensity. — *Lord Rosse's Address before the Royal Society.*

LAMP-LIGHTING BY ELECTRICITY.

THE Paris correspondent of the *London Times* writes as follows : — "A rapid and scientific mode of lighting and extinguishing public gas-burners has been invented by a person named Villatte. The opening of the burner of each lamp is covered with a piece of soft iron, mounted upon a hinge. In connection with this is a wire, extending from a galvanic battery the entire length of the service of the gas-lamps, and close to the orifice of each burner is a small slip of platinum. The soft iron, becoming a magnet when acted upon by the electric fluid, opens or closes the orifice, according to the motion imparted to it; the platinum ignites when it is necessary to light the lamps; and thus every lamp in a large town may be lighted or extinguished simultaneously, by a different action on the magnetized iron."

VELOCITY OF ELECTRICITY.

Dr. B. A. GOULD, JR. read to the American Association, at New Haven, and has since published in *Silliman's Journal* for January, a paper on the velocity of the galvanic current through the telegraph wires. It is probably the most elaborate communication which has appeared upon this interesting subject, containing some new views and much that is interesting. Any attempt to give a complete abstract would be impossible, and we must in a great measure confine ourselves to the results arrived at. The experiments upon which they are founded were made on Feb. 4, under the direction of the officers of the Coast Survey, on a line 1,045 miles in length, extending from Washington to St. Louis, with stations at Pittsburg, Cincinnati, and Louisville.

After glancing at the history of this question and the various experiments and views of Walker, Mitchel, Fizeau, and others, the author goes on to give a detailed and popular account of the whole mode of operation in determining this interesting, but difficult question, explaining the different sources of error and the means of obviating or eliminating them as far as possible. Disputed points in the theory of the electric action in these cases are discussed, and arguments brought forward on one side and the other. The questions upon which the most stress is laid are,—1st. Whether the stations on the line received the signal pauses successively in their order of distance, and after intervals directly proportionate to their distance from the place where the signal was made. Dr. Gould says, “We are justified in assuming that the signals given by making and breaking the galvanic circuit of the telegraph reach the several stations successively in their order of distance, and travelling with a finite and measurable velocity.” 2d. Whether we are to consider, when the two distant extremities of a line of wire communicate with the earth at a distance of many hundred miles from one another, that there is a special line of tension through the earth from one extremity to the other, and that a signal is communicated from terminus to terminus through the ground, in the same manner as it is through the wire, or may we consider the earth as a huge receptacle, to speak metaphorically, capable of receiving or imparting any amount of electricity at any time? The author sums up the argument on both sides, and says, “From all these considerations I infer that in the St. Louis and Washington experiments for velocity, which were, of all that have been made, the most favorable for exhibiting the phenomena, the signals were in no case transmitted through the ground.”

The general conclusion of the whole paper is as follows:—“Our results, obtained from different data, accord so well with one another, as to make it appear very improbable that the velocity of the propagation of the electric state produced in the telegraph wires by a galvanic battery is more than 20,000 or less than 12,000 miles per second.” By taking the mean of the results of all the experiments made by the Coast Survey, 15,890 miles per second is the velocity obtained.

Wheatstone, it will be remembered, obtained some years since a

velocity in copper wire of 288,000 miles per second, but a moment's consideration will show that the two results are not inconsistent. The wire used in the American experiments was of iron, and about three millimetres in diameter, while Wheatstone's copper wire was 1.7mil. in diameter. We have every reason for believing that the velocity with which electricity is conducted varies with the conducting power of the medium, and should therefore naturally anticipate that this velocity would be found greater in copper than in iron, for the conducting power of iron is less than eighteen hundredths of that of copper at 0° C. Moreover, Wheatstone used machine electricity of the highest possible tension.

Besides these results of Wheatstone and Gould, we may state that Walker has found a velocity of from 16,000 to 19,000 miles per second, Mitchel of 30,000 miles a second, and Fizeau and Gounelle, by experiments made the present year, of 63,200 miles in an iron wire 4 millimetres in diameter, and of 110,000 miles in copper wire 2.5mil. in thickness. The latter gentlemen also infer, that the two electricities are propagated with the same velocity, that the tension of the electricity has no influence on the velocity, that the velocity does not vary with the section of the conducting material, but only with its nature, and then not in the ratio of the conductive power, and that the discontinuous currents "experience a diffusion, in consequence of which they occupy a space greater at the point of arrival than of departure."

It is proper to add, that Dr. Gould suggests that, after all, the velocity is different at different parts of the line, and there are some facts which favor this suggestion.

Prof. Bache, in communicating to the American Association at Charleston Walker's results, referred to above, stated that one interesting fact observed in making these experiments is, that the telegraph line, when connected with a battery in action, propagates the hydro-galvanic waves in either direction, without interference. As several successive syllables of sound may set out in succession from the same place, and be on their way at the same time to the listener at a distance, so, also, where the telegraph line is long enough, several waves may be on their way from the signal station, before the first one reaches the receiving station. Two persons at a distance may pronounce several syllables at the same time, and each hear those emitted by the other. So, on a telegraph line of two or three thousand miles in length, in the air, and the same in the ground, two operators may, at the same instant, commence a series of several dots and lines, and each receive the other's writing, though the waves have crossed each other on the way.

DYNAMIC PHENOMENA OF THE LEYDEN JAR.

At the meeting of the American Association at New Haven, Professor Henry gave an account of his investigations of the discharge of a Leyden jar. On this subject he had made several thousand experiments. All the complex phenomena he had observed could be refer-

red to a series of oscillations in the discharge of the jar. If we adopt the hypothesis of a single fluid, then we shall be obliged to admit that the equilibrium of the fluid, after a discharge takes place, by a series of oscillations, gradually diminishes in intensity and magnitude. He had been enabled to show effects from five of these waves in succession. The means used for determining the existence of these waves was that of the magnetization of steel needles, introduced into the axis of a spiral. A needle of this kind, it is well known, is susceptible of receiving a definite amount of magnetism, which is called its saturation. Now, if the needle be of such a size as to be magnetized to saturation by the principal discharge, it will come out of the spiral magnetized to a less degree than that of saturation, by the amount of the adverse influence of the oscillations in the opposite direction to that of the principal discharge. If the quantity of electricity be increased, the power of the second wave may be so exalted that the needle will exhibit no magnetism; the whole effect of the first or principal wave will be neutralized by the action of the second. If the quantity of electricity be greater than this, then the needle will be magnetized in an opposite direction. If the electricity be still more increased, the needle will again exhibit a change in its polarity, and so on in succession, as the power of the successive waves is increased.

INTENSITY OF THE ELECTRIC SPARK.

M. MASSON, in a paper presented to the French Academy on May 20, gives the results of an investigation of some questions connected with the relations existing between heat, light, and electricity. He finds that the intensity of the electric spark is in an inverse ratio to the resistance of the circuit. "In comparing the intensities of many sparks produced simultaneously in the same circuit by a discharge of the condenser, I have arrived at the following results:—1. When several sparks are produced simultaneously in the same circuit by the discharge of a battery, their intensity is different and proportional for each to the square of the quantity of electricity furnished by the condenser, and to the tension of the electric fluid at the point of explosion. 2. If the negative pole of a spark communicates with the ground, the positive pole being isolated, the illuminating power is twice as great as if the positive pole communicated with the ground, and the quantities of electricity producing the explosion in these two cases are to each other as $\sqrt{2}$ to 1. In gases, the resistance to electric explosion is proportional to their pressure.

SINGULAR PROPERTY, AND EXTRAORDINARY SIZE AND LENGTH, OF THE SECONDARY SPARK.

In experimenting with my great magnet, a new property of the secondary spark has been discovered, and some very interesting facts elicited. I will premise that the helix, nearly a foot in diameter each way, when charged by the battery, draws up within it in a vertical position a huge bar of iron weighing 300 pounds, through a distance of ten

inches, presenting by far the most powerful magnet ever known. When the circuit with the helix is suddenly broken, a secondary spark is produced *eight inches in length*. The most interesting feature of this spark is the modification of its form and sound by the action of magnetism. When the spark is produced at a distance from the magnet, it is readily elongated to six or eight inches, and I presume might be obtained a foot or more in length if the wires were separated with the velocity of a cannon-ball. In this case there is little or no noise made by the spark, but as the spark is produced nearer to the magnetic pole the sound increases, until at last, when close to the pole, each spark makes a report as loud as a pistol. The spark also diminishes in length, and is spread out as large as the palm of the hand. There is an effect here somewhat analogous to that produced by a magnet upon the arc of flame between charcoal points. — *Prof. Charles G. Page, Silliman's Journal, Nov.*

CURIOUS ELECTRICAL PHENOMENA.

PROF. LOOMIS described to the American Association at New Haven some curious electrical phenomena observed in certain houses. "Within the past two years, several houses in the city of New York have exhibited electrical phenomena in a very remarkable degree. For months in succession, they have emitted sparks of considerable intensity, accompanied by a loud snap. A stranger, upon entering one of these electrical houses, in attempting to shake hands with the inmates, receives a shock, which is quite noticeable and somewhat unpleasant. Ladies, in attempting to kiss each other, are saluted by a spark. A spark is perceived whenever the hand is brought near to the knob of a door, the gilded frame of a mirror, the gas pipes, or any metallic body, especially when this body communicates freely with the earth. In one house, which I have had the opportunity to examine, a child, in taking hold of the knob of a door, received so severe a shock that it ran off in great fright. The lady of the house, in approaching the speaking-tube to give orders to the servants, received a very unpleasant shock in the mouth, and was very much annoyed by the electricity, until she learned first to touch the tube with her finger. In passing from one parlour to the other, if she chanced to step upon the brass plate which served as a slide for the folding-doors, she received an unpleasant shock in the foot. When she touched her finger to the chandelier there appeared a brilliant spark and a snap. After a careful examination of several cases of this kind, I have come to the conclusion that the electricity is created by the friction of the shoes of the inmates upon the carpets of the house. I have found, by direct experiment, that electricity is excited by the friction of leather upon woollen cloth. It may be thought remarkable that the electricity should be intense enough to give a bright spark. In order to produce this effect, there must be a combination of several favorable circumstances. The carpet, or at least its upper surface, must be entirely of wool, and of a close texture, in order to furnish an abundance of electricity. So far as I have had opportunity

to judge, I infer that heavy velvet carpets answer this purpose best. Two thicknesses of ingrain carpeting answer very well. A drugget spread upon an ingrain carpet yields a good supply of the fluid. The effect of the increased thickness is obviously to improve the insulation of the carpet. The carpet must be quite dry, and also the floor of the room, so that the fluid may not be conveyed away as soon as it is excited. This will not generally be the case, except in winter, and in rooms which are habitually kept quite warm. In warm weather, only feeble signs of electricity are obtained. The rubber, that is, the shoe, must also be dry, and it must be rubbed upon the carpet somewhat vigorously." In instances where persons are said to have drawn electric sparks from a coal stove and a common grate, Prof. Loomis considers it probable that the experimenter, and not the stove or grate, was the electrified body.

PROPER LENGTH OF LIGHTNING CONDUCTORS.

THE rule prescribed by the French Academy is, that a lightning-rod will protect a circle whose radius is twice the height of the rod; but Prof. Loomis cited to the American Association at New Haven an instance which, he says, "demonstrates to my mind that it is unsafe to rely upon a rod to protect a circle of a radius larger than one and a half times the height of the rod, at least upon the west side, whence most of our thunder-showers come." These observations drew out various remarks. Prof. Henry stated that he had found in trees struck by lightning that there would be no traces of electricity on the upper branches, but it appeared to strike at the main trunk. He had observed that, when the color of the electric discharge is red, it indicates that the electricity is very high.

USE OF GUTTA-PERCHA AS MEANS OF ELECTRICAL EXCITATION.

MR. W. H. BARLOW describes in Brewster's *Philosophical Magazine* for December a new electrical machine. It consists of a wooden frame carrying two wooden rollers, the lower one being about six inches in diameter, and having a handle attached to the axle. The upper roller is about half as large. A band of thin sheet gutta-percha, about four inches wide, is made to pass round the rollers, fitting them very tightly. Near the upper roller are two cushions covered with silk, and connected together so as to press upon opposite sides of the gutta-percha at their upper extremities, and opening towards their lower extremities at an angle of about twenty degrees. When the handle of the machine is turned, causing the gutta-percha band to pass over the rollers at a moderate velocity, electricity is given off about three or four inches below the cushions, and by applying a conductor the apparatus may be used as a common electrical machine. The quantity of electricity developed increases with the surface of gutta-percha. Gutta-percha may be excited both positively and negatively. If a strip about two feet long and two inches wide be laid on a surface and rubbed, the two extremities when suspended in the air repel each other, and the elec-

tricity developed is that termed "resinous." But if the strip be folded double and rubbed, the upper side exhibits "resinous," and the lower side "vitreous," electricity, and the two extremities attract each other.

A postscript describes an improvement on this machine, in which a thicker description of band is used. The two rollers are of equal size, and the rubbers, which are brushes of bristles, four in number, are placed outside the band and opposite the axis of each roller. A double conductor, connected by a curved brass rod passing over the top of the machine, is applied, similar in form to the conductor of the plate-glass machines; and there is a tightening apparatus, to correct the expansion and contraction of the band. The electricity given off appears to be of higher intensity, and, under favorable states of the weather, nearly as much in quantity as that of an ordinary plate-glass machine.

APPLICATION OF THE ELECTROTYPE PROCESS TO THE PRESERVATION OF INSECTS, FLOWERS, ETC.

AT the meeting of the Society of Arts on Dec. 12, 1849, Mr. Highton drew attention to Capt. Ibbetson's application of the process of electrotyping to the preservation of the form of natural objects, such as animals, insects, plants, &c. The process is as follows. As it would be impossible to coat the whole surface of the object with plumbago (which is the ordinary mode of preparing non-metallic substances for the process of electro-deposition), on account of the extreme delicacy and minuteness of some of the parts, the insect, leaf, or flower is first steeped in a solution of phosphorus, and afterwards in a solution of nitrate of silver; when the phosphorus causes the silver to precipitate upon the object, and thus form a very thin metallic coating over every part of it. Upon this a thicker deposit of metal is obtained by the electrotype process, after which two or three small holes are made through the coating, and the specimen is subjected to heat powerful enough to drive off all the moisture. — *London Journal of Arts*, Feb.

CONDUCTING POWER OF ACIDS.

IN a memoir presented to the French Academy on "the conducting power of acids and the development of electricity in the combination of acids and bases," M. Matteucci states the following observations and conclusions. It is proved incontestably, that there is a development of electricity in the combination of nitric acid and potash, even when there is no metal in the circuit, and that the current is directed from the alkali to the acid in the point where the chemical action is the most intense. However little the nature of the acids and alkalies which compose this quasi battery is varied, we easily perceive that nitric acid and potash form the strongest electric combination of this sort.

In comparing the conducting power of acids and alkalies as affected

by a variation of density, M. Matteucci obtained these results. In sulphuric acid, if we take as unity its conducting power when the density is 1.192, we find that at a density of 1.030 the conducting power is 0.301, and increases till at a density of 1.259 it is 1.000, after which it diminishes till at a density of 1.667 it is only 0.344. With nitric acid the quantity of hydrogen gas developed at the negative pole is up to a density of 1.076, the same as that with sulphuric acid, and in proportion as the density is increased the quantity of hydrogen diminishes, so that at a density of 1.315 there is no further development of it. With nitric acid the quantity of oxygen gas developed at the positive pole diminishes as the density of the acid increases. With solutions of nitric acid having a density of 1.076 to 1.162, the quantity of oxygen developed at the positive pole is always greater than that in a solution of sulphuric acid. The relation between the oxygen obtained in nitric and in sulphuric acid is as 1.2 to 1. It follows from these experiments, that in nitric acid it is the water alone which is decomposed. Nitric acid at a density of 1.315 conducts better than acid of a greater or less density. Nitric acid differs from sulphuric in this respect, that the former at its greatest density of 1.50 conducts better than at 1.10. A solution of nitric acid at a density of 1.076 has the same conducting power as sulphuric acid at its maximum, that is, at 1.192. With hydrochloric acid the conducting power increases from a density of 1.076 to 1.114, after which it decreases, and at 1.186 it conducts worse than at 1.162. At a density of 1.023 it has a conducting power equal to that of sulphuric acid at its maximum. The conducting power of oxalic and phosphoric acid increases with the density of the solutions. Phosphoric acid at 1.115 has the same conducting power as sulphuric acid at 1.021. A solution saturated with oxalic acid has about the same power as a very weak solution of sulphuric acid at a density of 1.022. The author then details some further experiments, and at the close remarks: — "It would, then, be impossible to conclude from these experiments that the development of electricity in the combination of acids and oxides is subject to the same law as is electricity developed in the oxidation of a metal. The great conducting power of very concentrated nitric acid explains, in part at least, the superiority of this acid over the others in the development of electricity produced by its combination with the oxides."

VARIATIONS OF THE MAGNETIC FORCES.

PROF. W. A. NORTON communicates to *Silliman's Journal* for November a paper on the diurnal and annual variations of the magnetic needle, in continuation of a former paper on the same subject.* The conclusions derived from both papers are as follows: — 1. The diurnal and annual variations of the horizontal magnetic intensity are due to the joint operation of the variations of temperature and of humidity. 2. The similar variations in the height of the barometer are attributable to the same causes, the variations in both cases following the

* See *Annual of Scientific Discovery*, 1850, p. 135.

same law, with the exception that the maxima of the one element occur at the same hours as the minima of the other. 3. The observed variations of the horizontal magnetic intensity are legitimate consequences of the thermal theory of terrestrial magnetism; granting that moisture has a magnetic action. 4. The deviations in the variations of the horizontal force from the law of proportionality to temperature, are caused by the deposition of vapor from the atmosphere, and its evaporation from the earth's surface. 5. The diurnal variations of the vertical magnetic intensity are for the most part in accordance with the idea that they arise from variations in the difference between the temperature at the station of the needle and that at a place north or south of it. 6. The connection between the diurnal variations of the declination and those of the horizontal force, which is undoubted, may be described as follows:—When the curve showing the diurnal variations of the horizontal force is concave upward, the declination (westerly) is increasing; when convex upward, it is decreasing. Consequently the maxima and minima of declination must be contemporaneous with the points of inflection of the curve of horizontal force. 7. The annual variations of declination appear to be mainly dependent upon an annual oscillatory movement of the isothermal line.

OXYGEN MAGNETIC.

THE Bakerian lecture was delivered on Nov. 28, by Prof. Faraday. We can now only glance at the highly interesting investigations laid before the Royal Society. One of the conclusions arrived at was, that the motions of magnetic and diamagnetic bodies toward each other do not appear to resemble those of attraction or repulsion of the ordinary kind, but to be of a differential action, dependent perhaps upon the manner in which the lines of magnetic force were affected in passing from one to the other during their course from pole to pole, the differential action being in ordinary cases between the body experimented with and the medium surrounding it and the poles. A method of showing this action with the gases is described, in which delicate soap-bubbles are made to contain a given gas, and then, when held in the magnetic field, approach, or are driven further off, according as they contain gases magnetic or diamagnetic in relation to air. Oxygen passes inwards or tends towards the magnetic axis. Perceiving that if two like bubbles were set on opposite sides of a magnetic core or keeper cut into the shape of an hour-glass, they would compensate each other, both for their own diamagnetic matter and for the air which they would virtually displace, and that only the contents of the bulbs would be virtually in a differential relation to each other, the author passed from bubbles of soapy water to others of glass; and then constructed a differential torsion balance, to which these could be attached, of the following nature:—A horizontal lever was suspended by cocoon silk, and at right angles to the end of one arm was attached a horizontal cross-bar, on which, at about an inch and a half apart, and equidistant from the horizontal lever, were suspended the glass bubbles; and then the whole being adjusted so that one bubble should be

on one side of the iron core, and the other on the other side, any difference in their tendency to set inwards or outwards from the axial line causes them to take up their places of rest at different distances from the magnetic axis; and the power necessary to bring them to an equidistant position becomes a measure of their relative magnetic or diamagnetic force.

In the first place, different gases were tried against each other, and when oxygen was one of them it went inwards, driving every other outwards. The other gases, when compared together, gave nearly equal results, and require a more delicate balance to determine the amount of their respective forces. The author now conceived that he had attained the long-sought power of examining gaseous bodies in relation to the effects of heat and expansion separately, and proceeded to investigate the latter point. For this purpose he prepared glass bubbles containing a full atmosphere, or half an atmosphere, or any other proportion of a given gas, having thus the power of diluting it without the addition of any other body. The effect was most striking. When nitrogen and oxygen bubbles were put into the balance, each at one atmosphere, the oxygen drove the nitrogen out powerfully. When the oxygen bubble was replaced by other bubbles containing oxygen, the tendency inwards of the oxygen was less powerful; and when what may be called an oxygen vacuum (being a bulb filled with oxygen, exhausted, and then hermetically sealed) was put up, it simply balanced the nitrogen bubble. Oxygen at half an atmosphere was less magnetic than at one atmosphere, but more magnetic than other oxygen at one third of an atmosphere, and that at one third surpassed a vacuum. In fact, the bubble with its contents was more magnetic in proportion to the oxygen it contained. On the other hand, nitrogen showed no difference of this kind. Other gases (except olefiant and cyanogen) seemed in this first rough apparatus to be in the same condition.

Hence the author decides upon the place for zero, and concludes that simple space presents that case. When matter is added to space, it carries its own property with it there, adding either magnetic or diamagnetic force to the space so occupied in proportion to the quantity of matter employed; and now, thinking that the point of zero is well determined, he concludes to use the word *magnetic* as a general term, and to distinguish the two classes of magnetic bodies into paramagnetic and diamagnetic substances. — *Brewster's Philosophical Magazine, Supplement.*

Owing to the importance of this subject, we insert a somewhat more popular report of this lecture from the *Mining Journal*.

After stating that he had shown, three years since, that oxygen is highly magnetic, he said he had of late, by means of a peculiar differential torsion balance, ascertained that as the oxygen is dense or rare, it gains or loses for a given volume proportionably of its magnetic power, and that as its temperature is lowered or raised, it also gains or loses in the degree of its magnetic force. Nitrogen undergoes no changes of this kind; but the atmosphere, as a whole, is affected through the oxygen it contains. These changes are within the range

of the daily variation of temperature, and the air thus heated and cooled affects the lines of magnetic force which pass through it in their course from the earth into space. As the sun rises and comes onward in relation to any given place, the atmosphere beneath is affected, so as to cause the lines of magnetic force to diverge within the heated mass, and as the sun passes away, and air of lower temperature than the mean is produced, the lines of force tend to converge. It is not assumed that the hot or cold air acts at once upon the needle, but upon the great system of magnetic forces, which, emanating from the earth, pass, as it were, through the atmosphere into the regions of space, and, because of their polarity, return to the earth again. When these are affected in any one part, needles everywhere upon the surface of the planet are also affected in proportion to their distance from the seat of action, following in their position the force of the curve which governs them. Upon a first comparison of the alteration which should occur in the lines of force at any given place for a given hour with the magnetic observations made at that place, the directions of the variations, both of the declination and inclination, are found to accord so well with the theoretical deductions, as to create a strong expectation that the assigned cause is the true physical cause of the annual and diurnal variations, and of many of the irregular variations that are made evident in the records of the magnetic observatories.

MAGNETO-OPTIC PROPERTIES OF CRYSTALS.

MESSRS. TYNDALL AND KNOBLAUCH presented to the British Association, at Edinburgh, a paper on "the magneto-optic properties of crystals, and the relation of magnetism and diamagnetism to molecular arrangement." Their conclusions, derived from the examination of more than a hundred natural crystals, are thus summed up:—"We have on the one side four new forces assumed, the optic attractive and the optic repulsive forces, the magno-crystallic and the magneto-crystallic forces; and on the other side no new force whatever, but simply that modification of existing forces which we have named electropolarity. By attention to the compression of amorphous bodies, every single experiment cited can be reproduced."—*London Athenæum*, Aug.

POWERFUL MAGNETS.

SIR DAVID BREWSTER exhibited to the British Association two powerful magnets made by a process devised by M. Elias, and manufactured by M. Logeman, at Haerlem. One of them, a single horse-shoe magnet, weighing about 1 lb., is capable of lifting 28½ lbs., and the other, a triple horse-shoe magnet of about 10 lbs. weight, is capable of lifting about 150 lbs. Similar magnets are made by the same person, capable of supporting 5 cwt. They are made by some peculiar process, in which a helix of copper and a galvanic battery are used; and are so permanent that they suffer little, if at all, from having their soft iron guards forced off several times abruptly. They are accom-

panied by small strops, made with fine emery, for cleaning and polishing the poles previous to use, which is found to be of much consequence. The smaller magnet has twice the power expressed by Haecker's formula for the best artificial steel magnet, and even when a disk of letter-paper is interposed between the poles and the keeper, it will sustain the weight indicated by that formula. It will support its own weight at a single pole, and in this property it resembles the cylindrical bar-magnets now made in the electro-magnetic helix, and used in the magnetical observatories. These magnets are manufactured at a cheap rate, even when possessing great power. — *London Athenæum*, Aug.

MAGNETIC POWER OF GLASS DERIVED FROM THE FUSION OF ROCKS.

In a paper presented to the French Academy, Jan. 28, "on the magnetic power of glass produced by the fusion of rocks," M. Delesse concludes that this power in glass is sometimes greater and sometimes less than that of the rock from which it is derived, and, since the chemical composition is nearly the same, it is evident that the magnetic power of a substance may increase or diminish without any change in its chemical character.

THE SOLAR SPECTRUM.

At the meeting of the French Academy, on May 13, Sir David Brewster presented a paper on the solar spectrum, in which he notices particularly his observations, made during fifteen years, upon that portion of the spectrum beyond the limit A of Fraunhofer, which, he believes, has never been examined by any other person. This new portion is about equal in length to the space between A and B. In it he has detected five principal lines, and a large number of smaller ones, with several bands of greater or less size, and possessing very various degrees of illumination. The most remarkable portion of this region of the spectrum is a group of twelve lines near A, and on its least refrangible side; they are farther and farther apart in proportion as they are farther removed from A. He has also discovered nine or ten very feeble bands in the portion of the spectrum between A and B, in that part of it which forms the extremity of the spectrum of Fraunhofer. From his observations, Sir David Brewster concludes that the spectrum consists of an immense number of bands of different intensities separated by lines of different sizes. It is probable that these bands are only the effects of the absorption of the atmosphere, and that observations made in the higher regions of the air would give the spectrum as represented by Fraunhofer, marked by distinct lines only. The fact that the atmosphere has a most important effect in modifying the solar spectrum does not admit of a doubt. In the spectrum formed by the burning of nitre upon carbon, there are some brilliant red lines, coinciding not only with the double lines A and B, but with each of the eight lines composing the group *a* of Fraunhofer. Similar bands

have been observed in the space between D and E in the spectrum given by the burning of nitrate of strontia in the flame of alcohol.

ON THE SENSATION OF LIGHT.

MR. JONES, in a recent paper before the Royal Institution, remarks, that the sensation which we experience in consequence of an impression upon the eye is called light, and the external agent which commonly causes the impression is also designated by the same name. But the sensation and the external agent which, by its impression on our optic nerve, excites in us the sensation, are totally different things. Some years ago a remarkable medico-legal case occurred in Germany, in which the sensation of light excited by a blow upon the eye was confounded with the agent light. In this case a worthy clergyman was assaulted one dark night by two men, one of whom struck him on the right eye with a stone. By the light which streamed from his eye in consequence of the blow, the clergyman alleged that he was able to see and recognize the man who committed the outrage. The question whether this were possible having been raised, it was referred to the official district physician, who thought that there was some probability in the clergyman's allegation, though he did not fully admit it. Professor Müller, of Berlin, in commenting on this curious case, very justly observed, that, if the physician had pressed upon his own eye in the dark, and tried to read by the light thereby emitted, he would probably have come to a more decided conclusion. — *Athenæum*, June.

THEORY OF COMPLEMENTARY COLORS.

M. MAUMENÉ, in a letter to the French Academy, describes an experiment, which is interesting as regards the demonstration of the theory of complementary colors. It is well known that the combination of the complementary colors produces white; and this is usually shown in lectures by employing two glasses, one of a red and the other of a green color, the tints of which, although of considerable intensity, entirely disappear during the simultaneous interposition of the glasses between the eye and the source of light. M. Maumené several years since arrived at the same result by using colored liquids, and especially by mixing a solution of cobalt with one of nickel, both perfectly pure, and so diluted that their color is nearly of equal intensity. The rose-red color of the cobalt is completely destroyed by the green of the nickel, even in concentrated solutions, and the mixed liquid remains colorless. — *Journal de Chimie*, March.

THE UNDULATORY AND CORPUSCULAR THEORIES OF LIGHT.

ARAGO has given to the French Academy an account of the entire success of an experiment, suggested by himself in 1839, for settling beyond the slightest doubt the long dispute between the corpuscular and undulatory theories of light. Hitherto it has been found impossi-

ble to execute the experiment for want of the proper instruments. That difficulty has been at last vanquished, and the result is the complete defeat of the Newtonian corpuscular theory. The experiment was made by M. Foucault, by means of an ingenious instrument founded upon the revolving mirror of Wheatstone, and is thus described by Arago: — "Let us cause to start from two points near each other, in the same vertical line, two rays of light parallel to the horizon, and let their direction conduct them to two points on the median line of a mirror turning about this line. The direction in which the two rays will be reflected will depend upon the moment at which they reach the turning mirror. If they arrive simultaneously, they will be reflected simultaneously by the mirror, and exactly as if the mirror itself were still. The rays will remain parallel, as they were before reflection. But if one of the rays, accelerated in its movement, reaches the mirror sooner than the other, then the two reflections will not take place at the same instant; the mirror will have turned in the interval, and the two rays of light, striking it at different angles, will be reflected in diverging directions. According to the corpuscular theory, light moves more quickly in water than in air. According to the undulatory theory, the reverse is true. Let us cause, then, one of the rays, the superior, for instance, to traverse a tube filled with water before reaching the mirror. If the theory of emission, or the corpuscular theory concerning the nature and propagation of light be true, the movement of this ray will be quickened, and it will reach the mirror first, and be reflected before the inferior ray, forming with it a certain angle; and the deviation will be such that the inferior ray will appear more advanced than the other, and will seem to have been drawn on quicker by the turning mirror. Now, suppose the undulatory theory to be true; the tube of water will retard the movement of the superior ray. It will reach the turning mirror later than the inferior ray, and, of course, will be reflected later. The position of the reflecting surface will be no more the same as when an instant before the inferior ray was reflected. The two rays will form the same angle as in the first hypothesis, but with this remarkable difference: the deviation will be such, just the reverse of what appeared in the first hypothesis, that the superior ray will now be the more advanced, and always in the direction of the rotation of the mirror."

M. Foucault thus states the result: — "Light traverses water more slowly than air; and the difference is detected by the deviation of the ray, which is reflected at a given moment from a mirror turning with great velocity. *Cæteris paribus*, the deviations appear sensibly proportional to the indices of refraction of air and of water. No doubt is possible as to the reality of these results. They have been obtained in two different manners. The two deviations were, in the first place, observed successively, and found to be unequal, the velocity of the rotation of the turning mirror being the same. The deviations were afterwards observed simultaneously, which makes the experiment more satisfactory." Similar experiments made by Fizeau and Breuet conduct to the same conclusion.

THE EXTINCTION OF LIGHT IN THE ATMOSPHERE.

IN a letter from Madras, Capt. Jacob refers to Prof. Forbes's investigations upon the extinction of light in the atmosphere, and adds, — "On commencing work with heliotropes in 1837, I soon found that for long distances it was necessary to enlarge the apertures more than in the simple ratio of the distance; and before the end of the first season I had formed a scale of apertures for corresponding distances, which, when finally corrected, stood as follows:—

Aperture. Inches.	Maximum Distance. Miles.	Maximum Distance, without absorption.
0.5	15	15
1 0	23	30
2.0	33	60
4.0	45	120
8.0	60	240

"At these distances the light was just visible to the naked eye in clear weather, and when seen over a *valley*. On one occasion I employed a heliotrope at $6\frac{1}{4}$ miles, and used an aperture of one sixth of an inch, and found it rather brighter than usual, so that probably $6\frac{1}{2}$ or 7 miles would be the normal distance for that size. But there is no need to employ a conjectural quantity; and if the rate of absorption corresponding to the above be computed, so close an agreement will be found, as may entitle the numbers to be looked on as something better than mere estimates. The mean of the whole shows a loss of .0610 in passing through one mile of atmosphere; with the barometer reduced to 30.0 inches, the quantity will be .0671. Hence the loss of light in passing from the zenith through a homogeneous atmosphere of 5.2 miles will be .303. I was much astonished at first discovering that the air had so great absorbent powers, and many ideas are suggested by the fact. We see at once how easily many of the planets may be rendered habitable to beings like ourselves. Mars may enjoy a temperature little inferior to our own by having a less absorbent envelope; and Venus may be kept as cool as we are, by having one more so." — *Proceedings of the Edinburgh Royal Society*, Vol. II. No. 36.

PROPORTION OF LIGHT REFLECTED AND TRANSMITTED.

ARAGO, in one of the series of papers on photometry which he has lately presented to the French Academy, states that, in the course of some investigations, it became necessary to know the quantity of light transmitted and reflected by a plane plate of glass at various angles, and as this was not to be ascertained from any book, he determined it experimentally. He found that at an angle of $4^{\circ} 32'$ a plate of crown-glass reflects four times as much light as it transmits; at $7^{\circ} 1'$ the reflected light is double the transmitted; at $11^{\circ} 8'$ the two are equal; at $17^{\circ} 17'$ the reflected light is half of the transmitted, and at $26^{\circ} 38'$ it is a quarter of the transmitted light. Arago then goes on to demonstrate the law known as the "square of the cosine," and shows

that, by its experimental determination, the way is opened for the solution of many interesting questions, such as the height of isolated clouds, the relative intensity of the bright and dark portions of the moon, the comparative intensity of the sun and the earth, whether the terrestrial hemispheres successively visible from the moon are more or less luminous as they contain more or less land and water, and a host of others. In a later paper the author mentions that no sensible portion of light is lost in the act of reflection and refraction at the first or second surfaces of a plate of glass.

REFLECTING POWER OF THE PLANETS.

PROF. LEWIS R. GIBBES, in a paper presented to the American Association at Charleston, states that he has made various observations upon the reflecting power of the planets, and, although the means and opportunities of observation are necessarily imperfect and liable to error, he finds that the relative reflecting power of Jupiter is three, that of Mars being unity. Saturn reflects light three and a half times more powerfully than Mars. Venus, as determined by observations subsequent to the reading of the paper, appears to have a much less reflecting power; in fact, the power of Jupiter in this respect is four times as great as that of Venus, which seems to be inferior even to that of Mars. The general conclusions arrived at are, — that it is certain that Saturn and Jupiter reflect light more powerfully than Mars, including under the term "reflecting power" all the agencies at the surface of the planet that affect the light in its course from the sun to the planet, and thence to the earth; that it is probable that the reflecting power is the greater the more distant the planet from the sun; that these results will serve to predict the epochs of equality of light, and thus prepare for observation.

EFFECT OF WATER ON POLARIZED LIGHT.

M. BIOT concludes, from a series of experiments, that water near its maximum of density, or near the freezing point, but still liquid, does not exercise any appreciable influence upon polarized light. — *Comptes Rendus*, March 11.

Light of the Clouds. — At the meeting of the French Academy on July 1, M. Arago gave an account of a balloon ascent, undertaken by Messrs. Bixio and Barral for the purpose of settling various interesting questions. Although they were provided with the best instruments, an accident prevented them from accomplishing their objects, and even put their lives in danger. They, however, attained a height of 5,900 metres, and traversed a cloud 3,000 metres thick, proving by experiment that the light reflected from the clouds is not polarized, and ascertaining that, notwithstanding the existence of a cloud of this thickness, the diminution of temperature was very nearly the same as Gay-Lussac found it when the sky was perfectly cloudless. At the last account the same gentlemen were preparing to make another ascent.

IDENTITY OF LIGHT AND HEAT.

MELLONI has just published, at Naples, and presented to the French Academy, on May 6, the first part of a work entitled "*La Thermo-crôse, ou la Coloration Calorifique*," the object of which is to show that the luminous and calorific rays possess the same heterogeneous constitution, proceed from one agent only, and from a single series of radiations, part of which affect the organs of vision, whilst the other are revealed to our senses only by phenomena which accompany the heating of bodies. In short, that rays of heat are distinct in kind and properties, like the rays of different colors, which, differing in refrangibility, compose white light.

Transmissibility of Heat. — A paper was presented to the French Academy on July 8th, by Messrs. Masson and Jamin, "On the transmissibility of heat." The object of their researches was to examine two theories of heat, — whether heat and light are the effects of different causes, or whether they are two different effects from a single cause; and to this end they repeated and extended the experiments of Melloni. The two most interesting points were the extinction of the dark rays of a solar spectrum by glass and by water, as stated by Melloni; and the calorific spectrum passing through glass of cobalt-blue, not presenting any alternations similar to the bright and dark bands of the solar spectrum so treated. Messrs. Masson and Jamin do not find heat extinguished by its transmission through glass or water; and they do find the same bands for heat as for light passing through blue glass. In short, they show that colorific and calorific extinction or transmission follow the same laws; moreover, they also show that the relation of the quantities of light and heat transmitted to the direct quantities is always identical, and that the speed and length of a wave of heat are also identical with those of light. Their results seem to warrant the following conclusions. 1. In all phenomena produced by a radiation of the same refrangibility, calorific and luminous, the relations of the quantities of heat and light before and after being acted upon are identical. 2. All vibrating modifications established in the case of light are found again, with the same intensity and the same numerical value, in the case of heat. This constant proportion in the effects is sufficient to prove the identity of causes.

Some observations communicated at the same time by Provostaye and Desains, "On the polarization of heat by simple refraction," go to confirm the above view, that the laws of radiating heat are precisely those of light. In regard to intensities, the numerical values are frequently the same in the two cases, provided rays the same in origin and refrangibility be used.

Moigno and Matteucci have noticed another fact connected with this question. In all cases the negative pole of a voltaic battery or pile becomes luminous previous to the completion of the electric arc, and is relatively much colder than the positive pole. Hence it is inferred that light is developed in virtue of some peculiar function of the negative pole of the battery, independent of the process of combustion which constitutes the phenomenon of the ordinary electric light; and

that heat is constantly developed with superior intensity at the positive end of any voltaic arrangement.

COMBINATION OF POLARISCOPE AND REFLECTING GONIOMETER.

MR. W. P. BLAKE, of the New Haven Laboratory, presented to the meeting of the American Association, in August, an instrument designed for taking the angles included between the optic axes of crystals and for use as a *reflecting goniometer*. The general arrangement of the instrument is similar to that of Wollaston's goniometer, but it is provided with a black glass reflecting-plate for polarizing light, which is also used to reflect the image of bars of the window or a string when measuring solid angles. The analyzing lens or eye-piece is either a tourmaline or Nichols prism, and is combined with small convex lenses of short focus, which are useful to enable the observer to obtain a distinct and clear image of the colored rings surrounding the optic axes, especially when the mineral to be examined is in thin plates. The mineral is held in the proper position, at right angles to the polarized ray, by means of a peculiar clamp or vice, which allows of such adjustment as will bring the plate of mineral into coincidence with the axis of rotation of the shaft to which it is attached. When the instrument is to be used as a goniometer, this clamp is taken off from the end of the shaft, and replaced by a contrivance for the adjustment of crystals, resembling that adopted by M. Mitscherlich; the polarizing eye-piece can also be removed and a small telescope substituted, or the angle may be taken without, as with the common goniometer of Wollaston.

In order to measure the angle between the optic or resultant axes of crystals, the instrument is placed near a window, so as to receive the light reflected from the clouds without interception. A string is then stretched across the window space at such a height that its image will be in the field of view; it should cross the field horizontally and bisect it. A vertical string is also to be arranged so that its image crosses that of the other at right angles. The Nichols prism or analyzing piece is then turned or "*crossed*" so as to extinguish the ray polarized by the black glass reflector. The plate of mica or other mineral to be examined is then interposed between the polarizer and eye-piece, and turned until the position of the poles are found by means of the shape and position of the colored rings; it is then to be secured by means of the clamp, and if the plane in which the axes lie is found to be parallel with the vertical string, it is ready for measurement. 0° on the circle being brought to 0° on the vernier, the shaft is turned so as to incline the mineral to the polarized ray, and when the elliptical rings or dark spots around the pole are accurately bisected by the image of the horizontal string, the shaft is clamped to the circle, and both turned together in the opposite direction until the rings or spots around the other pole come into the same relative position; the angle through which the mineral has moved is then read off, and is the apparent inclination of the optic axes.

The instrument was constructed more especially for the optical ex-

amination of mica minerals, and as it is desirable that the mineralogical arrangement and classification of this species should be founded upon their optical properties, it becomes important that mineralogists should have in connection with a goniometer the means of readily determining the variety of such micas as come under their observation. Mr. Blake has used his instrument in this way, and gave to the Association the apparent angular inclination of the optical or resultant axes of several American micas. He is still engaged upon the investigation.—*Editors.*

DESCRIPTION OF THE MARINE OR WATER TELESCOPE.

WE find in *Jameson's Philosophical Journal*, for July, a detailed description of the water-telescope, the use of which among the Norwegians was noticed in the *Annual of Scientific Discovery* for 1850. It consists of a tube of metal or wood, of a convenient length, to enable a person looking over the gunnel of a boat to rest the head on the one end, while the other is below the surface of the water; the upper end is so formed that the head may rest on it, both eyes seeing freely into the tube. In the lower end is fixed (water-tight) a plate of glass, which when used is to be kept under the surface of the water. A convenient size for the instrument is to make the length three feet, and the mouth, where the face is applied, of an irregular oval form, that both eyes may see freely into the tube, with an indentation on one side to facilitate breathing, so that the moisture of the breath may not be thrown inside of the tube. Handles for holding the instrument are to be affixed to each side. The glass at the extremity of the tube should be surrounded with a rim of lead, one fourth of an inch thick and projecting forward 3 inches, so as to form a continuation of the tube. The weight of the lead serves both to sink the tube and in some measure to protect the glass. Holes should be made at the junction of the rim with the glass, in order to allow the air to escape and bring the water in contact with the glass.

The reason why we so seldom see the bottom of the sea or of a pure lake, where the depth is not beyond the powers of natural vision, is not that the rays of light reflected from the objects at the bottom are so feeble as to be imperceptible to our senses, from their passage through the denser medium of the water, but from the irregular refractions given to the rays in passing out of the water into the air, caused by the constant ripple or motion of the surface of the water, where that refraction takes place. Reflections of light from the surface also add to the difficulty, and before we can expect to see objects distinctly at the bottom, these obstructions must be removed. This is done to a very great extent by means of the water telescope; the tube serves to screen the eyes from reflections, and the water being in contact with the glass plate, all ripple is got rid of, so that the spectator looking down the tube, sees all objects at the bottom, whose refractive powers are able to send off rays of sufficient intensity to be impressed upon the retina, after suffering the loss of light caused by the absorbing power of the water, which obeys certain fixed laws proportionate to the depth of water passed through; for as the light passing through pure sea-water

loses half its intensity for each 15 feet through which it passes, we must from this cause alone, at a certain depth, lose sight of objects of the brightest lustre. The freedom of the water from all muddy particles floating in it forms an important element in the effective use of the water-telescope; for these act in exactly the same way, in limiting our vision through water, as a fog does through air. In a trial made with the instrument on the coast of Scotland, the bottom (a white one) was distinctly seen at the depth of 12 fathoms; and on a black rocky bottom, objects were so distinctly seen at 5 fathoms under water, that the parts of a wreck were taken up, the position of which was not known previous to its use. In the Western British Islands the water-telescope is in general use for seal-shooting, where it is sometimes merely a wash-tub, with a piece of glass fixed in the bottom. The seal when wounded always seeks the bottom, whence he never rises after death until washed ashore by the action of the sea; but by the simple contrivance mentioned, he may be found and raised by grappling irons. Robert Stevenson, a number of years ago, even made use of the water-telescope for examining the sand-banks in the River Tay, where the clearness of the water was much obstructed by muddy particles. He obviated the difficulty arising from this source by making the tube of considerable length, placing the glass at the lower end, and lowering the whole until within a short distance of the bottom. The tube, thus acting as a coffer-dam, set aside the dirty water, and enabled the bottom to be seen.

IMPROVED TELESCOPE.

MR. NASMYTH described to the British Association a new arrangement of the reflecting telescope, by which great additional comfort is afforded to the observer. It reflects the rays from the smaller mirror, which is convex, upon a diagonal mirror, placed near the larger speculum, by which they are sent off through the trunnion. The telescope is mounted on triangular supports, and on one side is placed a chair for the observer, the whole being fixed to a turn-table, and so constructed that it can be turned in any direction by the observer, without removing his eye from the glass. Such a degree of steadiness is thus attained, that the observer can have a star or other object in view for a whole hour. The telescope can in a few seconds be changed into a Newtonian, by removing the diagonal mirror, and placing it at the trunnion.

IMPROVEMENT IN THE MICROSCOPE.

A NEW method of viewing opaque objects under the highest power of the microscope (the $\frac{1}{8}$ and $\frac{1}{12}$ inch object-glasses) has recently been devised by Mr. Brooke. This is effected by two reflections. The rays from a lamp, rendered parallel by a condensing lens, are received on an elliptic reflector, the end of which is cut off a little beyond the focus; the rays of light converging upon this surface are reflected down on the object by a plane mirror attached to the object-glass, and on a

level with the outer surface. By these means, the structure of the scale of the podura, and the different characters of its inner and outer surfaces, are rendered distinctly visible. — *London Athenæum*, June.

NEW SOLID EYE-PIECE.

REV. J. B. READE stated to the British Association, at Edinburgh, that, by simply filling the eye-piece with water, he had been able to get rid of the two well-known defects of the common negative eye-piece, a play of false light and the formation of a false image, or, as it is generally termed, a *ghost*, of a planet or star. The addition of the water causes the ray of light to pass to the eye without suffering any inner reflection from the surfaces of the lenses of the eye-piece. It also makes the eye-piece positive instead of negative, while, at the same time, the magnifying power remains nearly the same, the magnitude and flatness of the field are preserved, and the achromatism is not disturbed. It is, however, desirable to make the inner surface of the field-lens a little convex, as the ray now passes out of glass into water, and not into air. This eye-piece has been tried, and is very highly spoken of. To avoid some little trouble arising from the use of water, the author proposes to substitute glass or rock-crystal for the water, and to cement the surfaces together with Canada balsam; in this case, the inner surfaces of the eye and field-lens must have a diminished radius of curvature. — *London Athenæum*, Aug.

CHROMATIC STEREOSCOPE.

SIR DAVID BREWSTER has described to the Royal Scottish Society of Arts a chromatic stereoscope, which consists of one lens $2\frac{1}{2}$ inches in diameter or upwards, through the margin of which each eye looks at an object having two colors of different refrangibility. The effect of this is to cause the two parts of the object thus differently colored to appear at different distances from the eye, just as in the lenticular stereoscope the two parts of an object that are nearest to one another in the double picture rise in relief, and give the vision of distance as of a solid figure. The instrument may consist of two semi-lenses, convex or concave, or of two prisms with their refracting angles placed either towards or from one another; and the effect is greatly increased if the lenses or prisms have high dispersive powers, such as flint-glass or oil of cassia. — *Civil Engineer and Architect's Journal*, Feb.

NEW OPTICAL INSTRUMENTS.

JAMESON'S *Philosophical Journal*, for January, contains a description of the following new optical instruments. 1. Polarizing spectacles, to enable naturalists and others to distinguish objects beneath the surface of the water. This instrument consists of a pair of Nichols prisms, so adapted as to prevent the transmission to the eye of the horizontally polarized ray reflected from the water, by which means the glare that prevents the light from penetrating below the surface is

destroyed. The effect is complete when the water is smooth and the angle with it 52° , but is partial at other angles. The prisms are fitted into common spectacle-frames, or may be used like an opera-glass. 2. Picture polariscope, the construction of which is the same as that of the preceding, except that the admission of a perpendicular, instead of a horizontal, ray is prevented. This instrument is to be used in inspecting pictures hung in a bad light or too highly varnished. 3. Polarizing diaphragm, which consists of two Nichols prisms, one being fixed, and the other rotatory through an angle of 90° on the same axis as the fixed prism. It is intended to be applied to the microscope, and by it the light can be rendered more or less brilliant, as it is desired. 4. Surgical polariscope to aid the oculist in examining the cornea of the eye. It is a Nichols prism placed in a tube behind a lens of long focus, which rotates freely on its own axis, to suit the varying plane of the polarized ray from the cornea, so that all glare is removed.

At the New Haven meeting of the American Association, Professor Snell, of Amherst, exhibited an instrument intended to illustrate the vibrations of a molecule of common or unpolarized light. In common light, the vibrations are not like those of sound, in the line of progress, nor are they like sea-waves, perpendicularly across the line of progress, in a fixed direction, but they are across in all directions. The instrument presented this changing direction of the vibration. A small ball of ivory, in front of a black surface, is made to fly back and forth with great rapidity, while the line of its motion gradually advances round the circle, somewhat like the hand of a clock. The mechanism which produces this motion is merely a toothed wheel, gearing into the interior of a toothed circle of about twice its diameter. If the revolving wheel has just half as many teeth as the larger wheel, the ball, as is well known, would describe a straight line, or ellipse, in one fixed direction; but if a single tooth be added to the wheel, the line, or the axis of the ellipse, will slowly make progress round the circle, and in this way the ball is made to produce the kind of oscillation proper to represent light. Professor Airy does not consider this gradual progress of the axis of the ellipse as a precisely correct representation of the case; but the molecule should be conceived to vibrate many hundreds of times in one and the same position, and then hundreds more in a new position, and so on. It is only necessary, then, to imagine the ivory ball to vibrate with such rapidity as to make a few millions of oscillations in each of its successive positions; or, to state a definite case, let it vibrate five hundred thousand times in each angular second of its progress, and yet let the ellipse of vibration make its entire rotation in the one thousandth part of a second of time, still the whole will not be too great for the truth, since the number is six hundred millions of millions per second.

Professor Snell also exhibited an arrangement by which the lecturer can enable his audience all at once to try the experiment of complementary colors in vision. The apparatus consists of two disks, one a foot or more in diameter, and perforated by three openings, and the other behind it painted with alternate white and colored sectors. While the

hinder disk is so situated as to show the colors through the apertures, the spectators look at a fixed point on the front disk till the eyes are a little weary, when the operator suddenly removes the colors, and renders the whole surface white; but instead of appearing white, the three apertures are seemingly occupied by a beautifully dilute tint of the complementary color.

SURVEYING INSTRUMENT.

A PATENT has been granted for an instrument for measuring distances in reconnoissances. Upon a tripod stand is mounted a horizontal axis, from which extends at right angles a radial arm, bearing at its extremity a telescope having its line of collimation parallel with the axis. The telescope is counterbalanced by weights on the opposite side of the axis. By making the axis revolve with the telescope and counterpoises, the telescope is with great facility and precision made to assume in succession two parallel positions, at the distance of twice the length of the radial arm on which it is mounted. On observing an object through the telescope in these two positions, the parallax will be apparent at a great distance, and its angular magnitude is measured by a micrometer attached to the telescope. The parallactic angle thus obtained gives the distance of the object, either by calculation or by reference to a table constructed for the instrument. It is said that this instrument may be made to measure a distance of forty or fifty miles or more. — *Patent Office Report*, 1849.

PRODUCTION OF LUMINOUS IMPRESSIONS ON THE EYE.

In a communication made to the Royal Society of Edinburgh, Mr. William Swan gives the following as the result of an investigation undertaken by him to ascertain the relation between the apparent brightness of a light and the time during which it acts on the eye.

1. When the eye receives, from a light of common intensity, a succession of flashes of equal duration, which succeed each other so rapidly as to produce a uniform impression, this impression will also have a constant intensity, provided the number of flashes in a given time varies inversely with the duration of each flash.
2. The brightness of the impression produced by flashes of light of a given intensity, which succeed each other as above, is proportional to the number of flashes in a given time.
3. When light of a given intensity acts on the eye for a short space of time, the brightness of the luminous impression on the retina is exactly proportional to the time during which the light continues to act. This law has been proved to be true for impressions lasting from $\frac{1}{18432}$ to $\frac{1}{24}$ of a second. The intensity of the impression produced by light which acts on the eye for .01 of a second, is almost exactly one tenth of the brightness of the light when seen by uninterrupted vision; and it is also ascertained that light requires about the tenth part of a second to produce its full effect on the eye.
4. Lights of different intensity act on the eye with equal rapidity.
5. Rays of different refrangibility act on the eye with equal

rapidity. 6. By comparison of these with other results obtained by Prof. Wheatstone, it is shown that the apparent brightness of the electric spark is only one ten thousandth of what it would become if the duration of the spark could be prolonged to one tenth of a second. These results were obtained by means of an instrument called a *sclonometer*, the invention of Mr. Swan. In a later communication made to the British Association, Mr. Swan applies these results to determine the limits of the velocity of revolving light-house apparatus.

SOLAR AND STELLAR DAGUERREOTYPES.

In the *Comptes Rendus* for June 3, M. Niepce furnishes a communication relative to some images of the sun, obtained by him through the agency of the photographic art. The pictures were taken upon glass prepared with albumen. A plate exposed five seconds showed a very visible and distinct image, of a deep blood-red color, much deeper in the middle than at the edges. A second plate, exposed ten seconds, presented the same difference between the centre and the circumference, but with greater intensity; in addition, it had a circle beyond the image in the form of a glory. These experiments seem to confirm the opinion expressed by Arago, that the photogenic rays emanating from the centre of the sun have more action than those near the edge or circumference.

Mr. Bond of the Cambridge Observatory has recently succeeded in obtaining a Daguerreotype picture of the star *alpha Lyrae* in the space of about 30 seconds, the image being transmitted through the great refractor, used without the eye-glass. The picture is quite distinct, and about the size of a pin's head. Mr. Bond, in announcing the fact, says:—"The question will doubtless occur, To what good purpose can this discovery be applied? One of the first direct applications of it would be the measurement of the angles of opposition and distance of double stars. It is interesting to be assured of the fact, that the light emanating from the stars possesses the requisite chemical properties to produce effects similar to certain of the solar rays, and that these properties retain their efficacy after traversing the vast distance which separates us from stellar regions. Of this distance some idea may possibly be formed, if we can imagine a plain of two hundred millions of miles in extent, at the distance of the star *alpha Lyrae*, and favorably presented to a spectator situated on the earth, appearing as a mere point, only measurable by the aid of an excellent telescope, furnished for an accurate micrometer; or that light, moving at the rate of 190,000 miles in a second of time, would require more than twenty years to traverse the intervening space. Yet such are the facts, and it follows that the ray of light which made the first impression on our Daguerreotype plates took its departure from the star more than twenty years ago, long before Daguerre had conceived his invention.

"Our experiments have also a bearing upon the nature of the light emitted from the stars. The images which we have thus far obtained are quite decided, having pretty distinct nuclei, although elon-

gated, and too broad for the nicer purpose of measurement. This apparent enlargement of the disk we attribute, in a great measure, to two causes. One is the variable nature of atmospheric refraction, when influenced by sudden changes of temperature. This trouble we hope to get rid of by increasing the sensitiveness of the surface receiving the impression. The other operation will then require less time, and, of consequence, be subject to fewer and less extensive vibrations. The other difficulty to be overcome is the irregular motion of the machinery which carries the telescope. Although the machinery at present attached to the telescope is the best that German ingenuity could devise, and answers a tolerably good purpose on ordinary occasions, yet it is deficient for our nicer operations. The telescope should, during the nicer process, be propelled with a uniform sidereal motion, in order that the successive rays from the star may fall on precisely the same part of the plate which is to receive the impression. If this be not the case, the image will be deficient in distinctness of outline, and unduly enlarged. To effect this, we intend to apply to our great equatorial a machine which we have devised for the purpose of producing uniform rotary motion. It is our purpose to pursue the subject of Daguerreotyping the stars, proceeding step by step from the brighter to those of lesser magnitude. We do not despair of obtaining, ultimately, faithful pictures of clusters of stars, and even nebulae."

The Daguerreotyping of stars and nebulae was first accomplished by some Roman astronomers, among whom M. Rondoni has been especially successful.*

PHOTOGRAPHY ON GLASS.

THE following new process for obtaining photographic pictures upon glass is communicated to the *London Athenæum* for June, by Mr. T. A. Malone:—To the white of an egg add its own bulk of water, and after the two are well mixed, strain the solution. A piece of plate-glass, thick or thin, is then properly cleaned, and afterwards coated with the albumen, which forms a film upon the glass so thin and transparent that the brilliancy of the glass is unimpaired; indeed, it is almost necessary to mark it, to know which side has been coated. The plate is then coated with iodine, and afterwards rapidly immersed in a solution of aceto-nitrate of silver. Allow it to remain until the transparent yellow tint disappears, to be succeeded by the milky-looking film of iodide of silver. After washing with distilled water, the plate is ready for the camera. After it has been submitted to the action of the light, pour over its surface a saturated solution of gallic acid. A negative Talbotype image on albumen is the result. Washing with a solution of hyposulphite of soda, until the yellow tint is removed from the shadows, completes the process.

But where is the novelty? Let us go back a step. While the gallic acid is developing its reddish-brown image, pour upon the sur-

* See *Annual of Scientific Discovery*, 1850, p. 141.

face a strong solution of nitrate of silver; the brown image deepens in intensity until it becomes black. Another change commences; the image begins to grow lighter, and, by perfectly natural magic, finishes by converting the black into white, presenting the curious phenomena of the conversion of a Talbotype *negative* into, apparently, a Daguerreotype *positive*, but by a very opposite agency, no mercury being present; metallic silver here (probably) producing the lights, while in the Daguerreotype it produces the shades, of the picture. Prof. Wheatstone has suggested the desirableness of substituting blackened wood, or blackened ivory, for glass plates; we should then probably have the novelty of a Daguerreotype on wood free from some of the disadvantages attendant on polished metal. The application of it to wood blocks, for wood engravers for certain purposes, has been also suggested.

IMPROVEMENTS IN PHOTOGRAPHY.

THE superiority of the Talbotype to the Daguerreotype is well known. In the latter the pictures are reversed and incapable of being multiplied, while in the Talbotype there is no reversion, and a single negative will supply a thousand copies, so that books may be now illustrated with pictures drawn by the sun. The difficulty of procuring good paper for the negative is so great, that a better material has been eagerly sought for; and M. Niepce has successfully substituted for paper a film of albumen, or the white of an egg, spread upon glass.* This new process has been brought to great perfection, and the pictures taken by it are regarded as the finest ever executed. Another process, in which gelatine is substituted for albumen, has been invented, and successfully practised by M. Poitevin, a French officer of engineers, and by an ingenious method, which has been minutely described in the proceedings of the Institute of France. M. Edmond Becquerel has succeeded in transferring to a Daguerreotype plate the prismatic spectrum, with all its brilliant colors, and also, in an inferior degree, the colors of a landscape. These colors are, however, very fugitive; yet, though no method of fixing them has been discovered, we cannot doubt that the difficulty will be surmounted, and that we shall yet see all the colors of the natural world transferred by their own rays to surfaces of both silver and paper. But the most important fact in photography is the singular acceleration of the process discovered by M. Niepce, which enables him to take the picture of a landscape, illuminated by diffused light, in a single second, or at most two seconds. By this process he obtained a picture of the sun on albumen so instantaneously, as to confirm the remarkable discovery, previously made by Arago, by means of a silver plate, that the rays that proceed from the central parts of the sun's disk have a higher photogenic action than those which proceed from its margin. This interesting discovery by Arago is one of a series on photometry, which that distinguished philosopher is now occupied in publishing. Threatened with a calamity

* See *Annual of Scientific Discovery*, 1850, p. 142.

which the civilized world will deplore, the loss of that sight which has detected so many brilliant phenomena and penetrated so deeply the mysteries of the material world, he is now completing, with the aid of other eyes than his own, those splendid researches which will immortalize his own name and add to the scientific glory of his country.

— *Sir David Brewster's Address, British Association.*

Among the discoveries in photography during the past year, the most prominent, perhaps, are those patented by Messrs. Talbot and Malone of England. The points embraced in their specification are: — 1. The use of plates of unglazed porcelain, to receive the photographic image. 2. A method of converting or changing negative photographic images into positive ones. 3. The employment of the vapors of iodine and bromine in photography, as a preliminary to the formation of images upon films of albumen, gelatine, or other substances of animal or vegetable origin, the employment of these vapors having been hitherto confined to their action on polished metallic surfaces. 4. A method of obtaining more complete fixation of photographic pictures on paper. 5. The use of varnished paper, or other transparent paper impervious to water, as a substitute for glass, in certain circumstances, to support a film of albumen, for photographic purposes. 6. Forming pictures or images on the surface of polished steel plates.

A communication to the French Academy by M. Evrard presents some additional facts. The great desideratum to be obtained in photography is a method of rendering the exercise of the art on paper at once simple, certain, and easy. To accomplish this he describes, — 1. A method of taking photographic sketches on dry paper, in place of the damped paper, as in the processes at present in use, thus removing the difficulties arising from the necessity of preparing the photographic paper at the place where it is required to be used. 2. A simple method of preparing this photogenic paper, so that it may be prepared and sold ready for the use of the amateur, who need not henceforth take the trouble of preparing it himself.

In another paper, M. Evrard details his method of obtaining the instantaneous formation of the image in the camera obscura. Fluoride of potassium, added to iodide of potassium, in the preparation of the negative proof, produces instantaneous images on exposure in the camera. To assure myself of the extreme sensibility of the fluoride, I have made some experiments on the slowest preparation employed in photography, that of plates of glass covered with albumen and iodide of potassium, requiring an exposure at least sixty times longer than the same preparation on paper. On adding the fluoride to albumen and iodide of potassium, and substituting for the washing of the glass in distilled water, after treatment with the aceto-nitrate of silver, a washing in fluoride of potassium, I have obtained the image immediately on exposure in the camera. This property of fluoride of potassium is calculated to give very valuable results, and will probably cause, in this branch of photographic art, a change as radical as that effected by the use of bromine on the iodized silver plates of M. Daguerre.

CRAYON DAGUERREOTYPES.

A VERY beautiful process for obtaining crayon Daguerreotypes has recently been discovered by Mr. Mayal, of London, formerly of Philadelphia. This gentleman, refusing to take out a patent, has published the process in the *London Athenæum*. It is as follows:—Take a Daguerreotype image on a prepared plate as usual, taking care to mark the end of the plate on which the head is produced. When taken, and before mercurializing, remove the plate from the holder, and place it on a plate of glass prepared as follows. Cut a piece of thin plate-glass of the same size as the Daguerreotype plate, glue upon one side of it a thin oval piece of blackened zinc, the centre of the oval to coincide with that of the image upon the plate. Having carefully placed the glass thus prepared, expose the whole to daylight, for twenty seconds. The action of the light will obliterate all traces of the image from every part of the plate, except that covered with the blackened zinc, and also, from the thickness of the glass, the action will be refracted under the edges of the zinc disk, and will soften into the dark parts. Mercurialize the plate as usual; the image will be found with a halo of light around it gradually softening into the background, that will at once add a new charm to these interesting productions. By grinding the glass on which the disk is fixed, and by altering the shape and size of the disk, a variety of effects may be produced which every ingenious operator can suggest for himself.

New Way to obtain Groups.—A pleasing experiment may be performed, by covering successively different portions of the Daguerreotype plate, so as to exclude the operation of the light, except on that portion of its surface required for the image. A group of any number of persons can thus be represented, each one being obtained at separate sittings. The process is as follows:—Take several pieces of black paper, each paper having an opening, so arranged that no two will expose the same part of the plate to the operation of light. Coat the plate as usual, place one paper in the holder, over the surface of the plate, and observe that the representation in the camera corresponds in position upon the ground glass with that of the aperture in the paper. When one impression has been taken, the plate should be kept in the dark, and not exposed to the vapors of mercury until all the desired impressions have been obtained. At each sitting, the paper must be changed, and there is no difficulty in producing likenesses of several persons on the same plate, each without the knowledge of the others having ever sat. In this way the most ludicrous contrast of individual appearances may be produced, as, for instance, of an old maid and a young fop. — *Daguerrean Journal*.

NEW THERMOMETRIC SCALE.

MR. S. M. DRACH, of London, has recently published an account of a superior thermometric scale invented by himself. The prominent feature of this plan is, that *no negative degrees are necessary*, except for some chemical purposes and extraordinary arctic temperatures.

Mr. Drach proceeds to demonstrate his theory in the following manner. Having lately had occasion to advert to the superior practical utility of Fahrenheit's thermometric scale, as not ordinarily requiring decimal divisions and negative degrees like its congeners, it occurred to me that a superior scale was feasible by dividing the distance from -40° Fahr. up to the boiling point, $+212^{\circ}$ Fahr. (100° Centigrade, or 80° Reaumur), into one thousand degrees, placing zero at the temperature first named. Thus one of the new degrees proposed by Mr. Drach would equal $0^{\circ}.252$ Fahr. $= 0^{\circ}.140$ Cent. $= 0^{\circ}.112$ Reaum. And thus negative degrees are chiefly dispensed with. Ten years since, Mr. Drach published a tract showing that the idea of an absolute degree of cold expressible by a thermometer involved some fallacy. The conclusion therein arrived at, and now sustained by him, is, that every substance has its own minimum temperature for maximum density, above or below which it expands just as water on each side of 39° Fahr.; the latter fluid having the lion's share of this peculiarity, just as magnetism is ordinarily visible in iron above all other metals, resembling in some sort the electric affinity so common in chemical combinations.

COMPARISON OF FAHRENHEIT AND CENTIGRADE THERMOMETERS.

M. ABBADIE observes that the usual formula for comparing Fahrenheit and Centigrade ($C = \frac{(F - 32^{\circ}) \times 100}{180}$, when C and F represent respectively the degrees of the two thermometers) supposes that 180° Fahrenheit just equals 100° of Centigrade; but in France the height of the barometer for gradation is 760 millimetres, while in England it is 30 inches, equivalent to 761.9862 millimetres. The Centigrade scale corresponding to 212° F. is therefore 100.0727 degrees. To this correction there is still another (for instruments made at London and Paris), amounting to one tenth of the preceding, which depends on the difference in the intensity of gravity at London and at Paris. Applying these two corrections, the Parisian scale should stand at 100.08066° , when the London scale marks 212° . The formula for correction then becomes $C = \frac{(F - 32) \times 100.08066}{180}$. The correction is small; but in exact observations the thermometer is read to 0.08 degrees; and it is desirable that even a slight error should not be added to errors of observation. — *L'Institut*, No. 854. *Silliman's Journal*, Sept., 1850.

EUHARMONIC ORGAN.

MESSRS. ALLEY AND POOLE, organ-builders, of Newburyport, have produced an invention which has excited much attention and admiration in the musical world. It is termed the *euharmonic organ*. Its advantages and the improvements introduced are of such a nature, that a description of them can be rendered intelligible only to those who have some knowledge of the science and practice of music. Two papers on the subject have appeared in *Silliman's Journal*, and a paper was also read to the American Association, at New Haven, but the

best account appeared in *Littell's Living Age*, No. 329, written by Hon. S. A. Eliot, and it is from this that the following description is taken.

The difficulty of tuning fixed instruments with only twelve sounds to the octave, so that the same pipe, or the same string, of one uniform pitch, shall fit all keys in which music may be written, is so great, that it is set down as an impossibility, which in truth it is. Twelve sounds cannot be made equivalent to fifty. But it has also been deemed an impossibility to construct an organ, or a piano, so that it may produce the whole fifty-three commas of an octave, and yet be subject to the control of a single pair of hands. Several attempts have been made to attain this object without success; and at last it has come to be regarded as a settled impossibility. It is manifest that the extreme difficulty of producing nice gradations of sound upon a string of ten or twelve inches in length, such as those of the violin, will be greatly diminished upon those of the piano-forte, which range from one foot to five or six feet in length; or in the pipes of the organ, so many of which are longer yet, and where the two dimensions of length and diameter are equally important in the production of the required variety of tones. But the difficulty does not consist principally in the production of the great number of sounds. That can be done with the utmost exactness by regulating on mathematical calculation the vibrations of the string, or the capacity of the pipe, when they are of the proper length and size for a piano-forte or an organ. The difficulty is to adjust the mechanical apparatus which is necessary to produce the precise vibrations which are wanted for a given piece of music, so that they can be used with all the rapidity which is desirable.

This has been accomplished at last, in a single instance, but on a principle which can be applied indefinitely without risk of failure, and which makes the single instance decisive, therefore, of immense progress. An organ has been constructed with five stops, and furnished with the requisite number of pipes to give perfectly the chords in all music written in eleven different keys, viz., in the natural key, and in any key of not more than five sharps or five flats. Music in six, or seven, or more of either flats or sharps, cannot be performed with exactness on this instrument. To the extent named it is mathematically exact; the harmony it produces is true, and the effect on the ear singularly delightful. In tuning a common organ or piano by equal temperament, the imperfection of the divisions of the octave is distributed, as well and as equally as it can be, among all the tones; i. e. none are mathematically exact. If the third were made precisely accurate, the fifth would be farther from an exact chord than if the one be a little sharpened, and the other a little flattened, and so of other intervals. The consequence is that no two strings of a piano, and no two pipes of an organ are in perfect tune. They sound more or less discordantly. But with the new construction of the organ this is not so. There are pipes enough to give every sound required in eleven keys with absolute exactness. Not only does this instrument produce perfect combinations within itself, instead of imperfect ones, but it is capable of

exact unison with the intonations of the only instrument, except the violin, which approaches perfection, viz. the human voice. The power and volume of sound issuing from pipes of a given size are also increased.

The new organ remains in tune for a remarkable length of time. It seems as if there were some power of self-correction and adjustment in it; as if the little derangements caused by the changes of the atmosphere were set right by merely playing on the instrument. The error produced by change of temperature is so slight, that it is corrected by the action of the pipes upon each other. Common organs require to be tuned as often as four times a year, but the new organ was built a year ago, was voiced and tuned when it was set up, and has never been tuned since, with the single exception that the reeds were lowered a trifle in the winter, and have been raised again since the warm weather returned. It is in perfect tune still, notwithstanding it has been taken down, moved thirty miles, and set up again, in the course of the year, *without being tuned*.

The advantages of this organ then are,—1. It gives, perfectly, every musical tone in all the keys for which it is constructed, thus creating a new delight in listening to all music, whether melody or harmony; for, practically, no music has hitherto been performed on an organ or a piano-forte in perfect tune. 2. It harmonizes exactly with the human voice, which no other organ and no piano-forte, as now tuned, can do. 3. It increases the apparent volume of sound, i. e. a given number of pipes opened in this organ, in perfect tune, will have more power than the same pipes in a tempered organ in imperfect tune. 4. It makes pleasing, and even delightful, many musical combinations, or chords, which are painful when produced on a tempered organ. 5. It keeps itself in tune in a very remarkable manner.

The particular mechanical contrivances by which the object is attained are, of course, not visible on the outside; and, however difficult it may have been to invent them, they can, no doubt, be easily copied and multiplied by mechanics of no unusual skill. All that appears on the outside of the organ-case which differs from other organs is a row of pedals, very like the pedals of a sub-base, except that they stand out a little more from the organ. These are pedals which are adapted to the different keys; and when one is put down, it remains so as long as the player chooses; and it opens all the pipes suited to that key, in all the stops; or rather it allows them, and them only, to be opened on the application of the hands to the key-board. In order to change the key, another pedal adapted to the key desired must be put down; and in doing this, the pedal first put down is raised to its place by mechanism, so that the organist has only to touch one pedal in order to loose the pipes of the new key, and close those of the other at the same instant. The organ is played in all respects like a common organ, except that for changes of key the proper pedals must be put down. There is room enough for the sub-base pedals also.

The only objections to this organ are,—the difficulty there is in playing very elaborate pieces, but these are not the sort to be desired

in churches; the greater cost, but this is more than counterbalanced by its superior excellence; the greater space required; and the fact, that the organist must be a thorough master of the science of music. The instrument spoken of is placed in the chapel in Indiana Place, Boston.

ON CERTAIN PHENOMENA OF THE FORCED DILATATION OF LIQUIDS.

LET a strong capillary tube, closed at one end and drawn out at the other to a slender point, be filled with water at the temperature of 82° or 86° F.; if this tube is cooled down to 64° , so as to cause a certain quantity of air to enter it at the open point, and it is then closed, and again heated to 86° , and gradually higher, after a certain time the air is completely dissolved. If cooled to 64° , the original temperature at which the tube contained at the same time air and liquid, it is seen that the water continues to occupy the whole of the internal capacity, and maintains thus an invariable density between 82° and 64° . Its temperature may even be lowered still more. At this moment the least shock or collision, the least vibration, causes the instant re-appearance, with a sort of ebullition, a slight noise, and a shock more or less perceptible, of the gas dissolved in the water. It dilates rapidly, and in less than a second has resumed its *primitive* volume at 64° . The same phenomenon occurs with very many other gases and liquids, as well as with air and water. With mercury it does not occur. In these phenomena there are two things very distinct; — 1. An unstable supersaturation of the liquid by the gas produced under the influence of the pressure. 2. A state of forced dilatation of the liquid; the latter an instant before the vibration fills the volume which the gas occupies an instant after conjointly with it, and this volume is the same which the dilated liquid filled on an elevation of temperature. The variation of density thus produced is enormous; for water it is equal to $\frac{1}{420}$ of its volume at 64° , for alcohol to $\frac{1}{93}$, for ether to $\frac{1}{53}$. Such an effect could be produced otherwise only by a pressure of 50 atmospheres for water, and of 150 for ether. This phenomenon probably accompanies all supersaturations, but at variable degrees and in various directions, without being capable of being proved. The forced dilation of water and ether is also independent of supersaturation, it having been produced *in vacuo*. — *Berthelot, Comptes Rendus, June 24. Brewster's Philosophical Magazine, Aug.*

EFFECT OF PRESSURE IN LOWERING THE FREEZING POINT OF WATER.

In 1849, Mr. James Thompson, of Glasgow, read a paper before the Royal Society of London, in which it was demonstrated, that if the fundamental axiom of Carnot's theory of the motive power of heat be admitted, it follows, as a rigorous consequence, that the temperature at which ice melts will be lowered by the application of pressure. In this remarkable speculation, an entirely novel physical phenomenon was *predicted* in anticipation of any direct experiments upon the subject; and the actual observation of the phenomenon was pointed out as a highly interesting object of experimental research.

Experiments since made by Professor W. Thompson have verified the prediction, and it may now be considered as established, that the effect of pressure on water, and all other liquids which like it expand in freezing, is to lower their freezing point; and that a reverse effect, or an elevation of the freezing point by an increase of pressure, may be expected for all liquids which contract in freezing. The extent of the effect to be expected may in every case be deduced from Regnault's observations on vapor, if the latent heat of a cubic foot of the liquid, and the alteration of its volume in freezing, be known. — *Brewster's Philosophical Magazine, Aug.*

THE EXUDATION OF ICE FROM THE STEMS OF VEGETABLES,
AND THE PROTRUSION OF ICY COLUMNS FROM CERTAIN
KINDS OF EARTH.

AT the meeting of the American Association at Charleston, an elaborate and important paper was read by Prof. John Le Conte "on a remarkable exudation of ice from the stems of vegetables, and on a singular protrusion of icy columns from certain kinds of earth during frosty weather." After referring to the little attention which phenomena of this nature have received, the author states that in a visit to the sea-coast of Georgia, in November, 1848, he had an opportunity of observing the remarkable deposition of ice around the stalks of certain plants, especially in the two species *Pluchea bifrons* and *P. camphorata*, both of which grow abundantly in wet soils, and along the road-side ditches of that section. The exudations are most abundant during the first clear frosty weather in November and December, when the earth is warm, and there is considerable difference between the temperature of the day and the night. When the temperature sinks towards daylight to about 28° or 30° F., or even lower, the surface of the ground is totally devoid of the slightest incrusting film of frozen earth, while hoar-frost is deposited in great profusion on all dead vegetable matter. At a distance, the accumulations of voluminous friable masses of semi-pellucid ice around the footstalks of the *Pluchea* present the appearance of locks of cotton-wool, varying from four to five inches in diameter.

The observations made by Prof. Le Conte appear to establish the following facts. 1. The depositions of ice are confined to the immediate neighbourhood of the roots of the plants, frequently commencing two or three inches from the ground, and extending from three to four inches along the axis of the stem. At this season the stalks are dead and dry to within about six inches of the earth, below which they are green and succulent, and the plant has a large porous pith, which is always saturated with moisture as high as six or seven inches from the base of the stem. 2. The ice emanates in a kind of ribbon or frill shaped, wavy, friable, semi-pellucid excrescence, "as if protruded in a soft state from the stem, from longitudinal fissures in its side," as described by Sir John Herschel, who noticed a similar phenomenon in the heliotrope. "The structure of the ribbons is fibrous, like that of the fibrous variety of gypsum, presenting a glossy silky surface,

the direction of the fibres being at right angles to the stem, or horizontal." Their number varies from one to five, all issuing in vertical or longitudinal lines, which are not always symmetrically disposed around the axis. When the icy excrescences exceed five inches in length, which they frequently do, they are usually considerably curled. 3. "Although," as Herschel observes, "the icy sheets seem to have been protruded from the interior of the stem, yet on examination they were found to terminate sharply at its surface, and in no instance did they connect with any formation of ice within. The point of attachment was, however, always on the surface of the wood, beneath the outer bark, which the frozen sheets had in every instance stripped off, and forced out to a distance." The only thing observed by Prof. Le Conte, differing from this description, was, that in very severe frosts the icy sheets were often connected with the formation of ice within; but from various circumstances it is obvious that in these instances the frigorific action was too intense to permit the phenomenon to be developed in a normal manner. 4. The phenomenon took place in the same plant during several consecutive nights, and when the wood was not rifted frequently from the same portion of the stalk. When the wood was split, the deposition of ice occurred lower down on the stem, till finally the stalks became completely rifted from the height of six or seven inches to the ground, and this is the reason why the exudations are seldom observed after mid-winter. 5. Stems cut off within three or four inches of the ground exhibited the phenomenon the same as those untouched. The icy sheets never issued from the cut surface, but from longitudinal lines commencing below it and extending towards the root. Plants transplanted to a box of moist earth exhibited the phenomenon much less strikingly than those left *in situ*.

Prof. Le Conte is of the opinion, for various reasons, that we must look to the moist earth for the supply of water necessary for the formation of these masses of ice. But before proceeding to the consideration of the question by what force and through what agency it is elevated and protruded, he remarks that, "impressed with the idea that the phenomenon is purely physical, having no connection with the vitality of the stem, it seemed reasonable that the remarkable exudation of icy columns from certain kinds of earth might be referred to a similar cause." He considers that his observations upon this phenomenon have established these facts among others: — 1. It occurs most strikingly when a warm rainy period terminates in clear freezing weather, with the wind from the west or northwest. It is developed at all temperatures below 30° F.; and in situations which are persistently wet it is always in proportion to the depression of temperature. 2. It occurs in soils that are rather firm but not very compact, and is seldom if ever observed in rich, mellow, alluvial soils, abounding in vegetable matter. 3. The general appearance of the phenomenon is that of a vast number of filaments of ice, forming in their aggregation fibrous columns resembling bundles of spun glass, emanating at right angles to the surface as if protruded in a semi-fluid state from an infinitude of capillary tubes in the ground. The structure of the columns is fibrous, presenting a fine silky, wavy, silvery surface,

and they are more or less transparent, depending apparently on the purity of the water and the state of aggregation of the icy filaments. Sometimes the fibres are readily separated; at others they are fused together. When examined by transmitted light, *transverse striæ* are observed to cross the filaments at intervals of from one tenth to one thirtieth of an inch. The columns vary in length from one to four or even five inches, and in size from mere threads to prismatic bundles of one fourth of an inch in diameter. 4. On examination the columns were found to terminate sharply at the surface of the earth, never being connected with any formation of ice below where the phenomenon was fully developed, and, in most cases, the soil from which they protruded was not frozen in the slightest degree, even in the severest weather, when the thermometer stood as low as 5° . Though the ground was not frozen, yet, on cautiously removing the icy columns, the moist clay was found to present a very porous appearance, as if perforated by a multitude of holes or spiracles, corresponding in position with the bundles of thread-like ice.

A careful examination of the two series of facts, with reference to the exudations of icy fringes from the stems of plants and the protrusion of columns of ice from certain soils, must convince every one that both of these phenomena should be referred to one and the same cause. If we admit this identity of cause, it must obviously be a purely physical one. The author then shows from various facts what cannot be this cause, confining himself more particularly to the phenomenon exhibited by the soil. It cannot be caused by the vapor in the general atmosphere. Nor can it be occasioned by the cold contracting a superficial stratum of earth, and thus forcing up the moisture which freezes at the surface. Nor, again, can it be owing to the exhalation of aqueous vapor from the comparatively warm earth beneath through spiracles, undergoing condensation and congelation at the surface, and thus protruding the column. Neither can the protrusion be ascribed to the mere expansion of water during the act of freezing in the capillary tubes of the clay. Though in the well-known expansion which water undergoes before congelation commences, we have a cause sufficiently universal and acting in the right direction, yet calculation shows that it is entirely inadequate for the production of the phenomenon. It being impossible for any of these to be the causes of the phenomenon, Prof. Le Conte offers the following as the most probable explanation of it. Let us suppose a portion of tolerably compact, porous, and warm earth, saturated with moisture, to be exposed to the influence of a cold-producing cause. Only a very superficial stratum of the soil would be reduced to the freezing point. As the resistance to lateral expansion is less at the surface than it is at a sensible depth below, the effect of the first freezing would be to render the apices of the capillary tubes or pores conical or pyramidal. The sudden congelation of the water filling the conical capillaries in the superior stratum would produce a rapid and forcible expansion, which, being resisted by the unyielding walls of the cone, would not only protrude, but project or detach and throw out the thread-like columns of ice in the direction of least resistance, or perpendicular to

the surface. This would leave the summits of the tube partially empty, and warm water, being drawn up from beneath by capillary attraction, would freeze and elevate the column still higher. After mentioning the various appearances which this theory accounts for, the author applies it to the exudations on plants, the only difference being, that the porous pith furnishes the supply of warm water from the earth, while the wedge-shaped *medullary rays* secure the mechanical conditions necessary for the development of the projectile force in the proper direction. The paper is of considerable length, and abounds in interesting details not to be compressed into a short abstract.

ACTION OF WAVES.

In the course of a paper read before the Society of Arts on "artificial breakwaters," by Mr. A. G. Findley, we find some interesting facts concerning the force and action of the waves of the ocean. The dynamic force exerted by sea-waves is greatest at the crest of the wave before it breaks, and its power in raising itself is measured by various facts. At Wasberg, in Norway, in 1820, it rose 400 feet, and on the coast of Cornwall, in 1843, 300 feet. The author cites numerous other cases, showing that the waves have sometimes raised a column of water equivalent to a pressure of from three to five tons to the square foot. He also proved by a table that the velocity of the waves depends on their length, — that waves of from 300 to 400 feet in length from crest to crest travel with a velocity of 20 to $27\frac{1}{2}$ miles an hour, and this, whether they are 5 or 54 feet in total height. Waves travel very great distances, and are often raised by distant hurricanes, having been felt simultaneously at St. Helena and Ascension, though 600 miles apart, and it is probable that ground swells often originate at the Cape of Good Hope, 3,000 miles distant. Nor do waves exert their force at or near the surface only, one instance being mentioned where a diving-bell at the depth of eight fathoms was moved five feet laterally in calm weather. The motion of "shingle" depends on the direction in which the surf strikes the shore, which is influenced by the direction of the wind, and this is shown from observations on the French coast to be in the ratio of 229 days from western quarters to 132 days from eastern quarters. At the British Association, Mr. Stevenson made a statement of the result of certain observations made by him on the force of waves with reference to the construction of marine works. The result of the experiments made gives a force of about $1\frac{1}{2}$ tons per square foot for the German Ocean, and of 3 tons for the Atlantic Ocean. The experiments from which these results were obtained were made at the Bell Rock and Skerryvore light-houses.

THE ATLANTIC WAVES.

At the meeting of the British Association at Edinburgh, Dr. Scoresby read an interesting paper on "the Atlantic waves, their magnitude, velocity, and phenomena," containing the result of observations made during two passages across the Atlantic in 1847-48. The most in-

teresting observations were on the return voyage, in March, 1848, in the *Hibernia*, on account of the high seas, and the peculiar construction of the upper works of the ship, which afforded various platforms of determinate elevation above the line of flotation. The first observation was on March 5, in latitude about 51° , longitude $38^{\circ} 50'$ W., the wind being about W. S. W., and the ship's course, true, N. 52° E. The wind had blown a hard gale the previous night, and still continued. Dr. S. took his station on the cuddy roof, the eye being 23 feet 3 inches above the line of flotation of the ship, and found that almost every wave rose so much above the level of the eye as to yield only the *minimum* elevation, showing that they were most of them *more* than 24 feet high (including depression as well as altitude), or, reckoning from the mean level of the sea, more than 12 feet. He then went to the larboard paddle-box where the eye was 30 feet 3 inches above the sea, a level which was very satisfactorily maintained during the instants of observation, because of the whole of the ship's length being occupied within the clear "trough of the sea," and in an even and upright position, whilst the nearest approaching wave had its maximum altitude. Here, too, at least half the waves were far above the level of the eye, long ranges extending perhaps 100 yards on one or both sides of the ship (the sea coming nearly right aft), rising so high along the visible horizon as to form an angle estimated at 2° to 3° , when the distance of the wave summit was about 100 yards. This would add nearly 13 feet to the level of the eye. This amount of elevation was by no means uncommon, and sometimes peaks of crossing, or crests of *breaking* seas, would shoot upwards at least 10 or 15 feet higher. The average wave was fully 15 feet or upwards, and the mean highest waves, not including the broken crests, about 43 feet above the level of the hollow occupied at that moment by the ship. The next day, after a storm of about 36 hours, which had abated several hours before the observation, so that the waves had perceptibly subsided, waves were noticed of 26 feet average elevation from ridge to hollow, and even of 30 feet; they were, however, of no great extent on the ridge.

At this time another subject of investigation was the period of the regular waves overtaking the ship, and the determination, proximately, of their actual width or intervals, and their velocity. The period of regular waves, in incidental series, overtaking the ship was, on the average, $16''.5$. A wave passed the length of the ship, 220 feet, in about six seconds, and an estimate gives 559 feet as the probable mean distance of the waves, or the width passed over between crest and crest. To this, however, an addition must be made, on account of the progression of the ship in the same direction, of 231.5 feet, giving 790.5 feet for the actual distance traversed by the wave in 16.5 seconds of time, being at the rate of 32.67 English statute miles per hour. Of the elements employed in this calculation, all but one may be deemed accurate, the doubtful one being the average distance from summit to summit of the waves; and even this must be very nearly correct. As to the form of the waves, it was found that it was less regular during the height of the gale than after the wind had begun to subside. —

London Athenæum, Aug.

TIDES OF THE GULF OF MEXICO.

AN interesting paper was presented to the American Association at New Haven by Prof. Bache, on the tides of the Gulf of Mexico, as observed by the officers of the Coast Survey, at Cat Island. The tides of the Gulf of Mexico, said Prof. Bache, present interesting peculiarities. They are generally, not universally, single day tides. Those at Cat Island are the type of this class. The discussions applicable to them, reduced to rule, would answer for all others of the class. The progress of such a discussion he proposed to present. The tides at the entrance to Mobile Bay are in part reduced, and new observations are being made there and at other points in the Gulf. The observations at Cat Island were made hourly, day and night, for a year. The average rise and fall is but one foot. There is one high and one low water, as a rule, in the twenty-four hours. The wind is supposed by navigators generally to cause these tides, but the hypothesis, when carefully examined, falls to the ground. The time of high water advances as the lunar day gains on the solar, until suddenly it shifts nine, ten, and twelve hours. The low waters follow the same law. The times of change are at or near the period when the moon crosses the equator. This points to the diurnal inequality, as shown by Mr. Whewell, as the source of the phenomenon.

An establishment useful to the navigator may be obtained by considering the luni-tidal intervals for the superior and inferior transits according to the moon's place north or south of the equator. Ordinary modes of discussion fail entirely. The curves of hourly observations for the year leave no doubt that the declination changes of the moon are those first to be looked to. Ordinary double or six-hour tides occurred always at and near the period of no declination, when they were near the quadratures. The tables for the whole year showed this, and the comparison of tides at the zero and maximum of declination showed that the time of occurrence (epoch) corresponded very nearly, at a mean, with the moon's position. The explanation of the tides was to be found in the interference of the semi-diurnal and of the diurnal tide waves.

Prof. Bache went on to develop the theory, and show that it accords nearly with the observations, and remarked that, should further examination confirm his conclusions, the two tides could be separately obtained from the observations, and discussed according to the known laws of lunar and solar action.

CURRENT CHARTS.

PROF. BACHE described to the American Association at New Haven the method used in the Coast Survey for showing the results of current observations. The paper was illustrated by diagrams of Boston Harbour.

"Observations being multiplied at different periods of the current, from slackwater to slackwater, they are projected upon diagrams showing at a glance the direction and velocity at any particular station.

The average of the results is usually obtained by inspection. Dividing the intervals between slackwaters into quarters, we give the mean results for those periods in a table, and usually place upon the chart arrows indicating the direction or set, and write at the extremity numbers showing the velocity or rate in miles per hour. In case of the observations made in Boston Harbour, the results were so unusually numerous, that the lines of direction were confusing to the eye, and the connection between the results was very difficult to seize. Through the pains taken, the motion of the water was traceable in nearly all its peculiarities, from the entrance through the tortuous passages among the islands, alternately narrowing and expanding, to the city wharves." On the current chart exhibited by Professor Bache, the direction and force of the currents were represented by lines, the distance between which is inversely as the rate in miles per hour. The reciprocals of the number of miles per hour are here represented by tenths of inches, currents of 0.2, 0.5, 1, 1.5, 2 miles per hour being represented by lines parallel to their directions, and distant 0.5, 0.2, 0.1, 0.75, 0.05 of the inch. The chart was on a scale of one 20,000th. The representation on one of the diagrams corresponded to the flood, and on the other to the ebb, referring to the motions of the current from slackwater to slackwater, and not to the tide or rise and fall of the water. If the current stations were very numerous, the straight lines tangent to the curves of motion of the water (set of the current) would become curves. It is easy for the navigator to seize the relations of the currents he will meet, even by these tangent lines, and to avail himself of the knowledge thus imparted of the direct lateral and eddy currents to avoid danger or to secure advantage.

WHIRLWINDS PRODUCED BY THE BURNING OF CANE-BRAKES.

MR. OL MSTED read to the American Association, at New Haven, a paper on whirlwinds produced by the burning of cane-brakes in the South. The canes in Alabama often grow to the height of thirty-five or forty feet. They are cut down, and, after drying for about six weeks, fire is applied to them in several places. As soon as the canes begin to burn, the air that is confined in their cells, and the watery vapor, burst them asunder. They generally explode through several cells at once, and thus are split in one continued line. These explosions, in burning a large cane-brake, produce a continued roar, like the discharge of musketry from an immense army. On account of the dry, combustible nature of the cane, when kindled, the fire advances with great rapidity, giving out flames of the deepest red, the intensity and richness of which color are incomparably finer than the flames which arise from the combustion of any other kind of wood. Together with the flame, there ascends a very dense, black smoke, resembling that which arises from burning camphor, or from the chimneys of gas-works or factories where bituminous coal is used. This smoke also far surpassed, in its dense, deep black color, any thing ordinarily observed.

The cane-brake visited by Mr. Olmsted covered a space of twenty-

five acres, and was set on fire at the part most distant from him. " Whirlwinds were now observed in the hottest part of the fire. They did not unite in one column, but were scattered throughout the fire, and several were formed at the same time. The first were on a comparatively small scale. Their height was from thirty to forty feet. To these succeeded others on a larger scale, until they reached the height of more than two hundred feet, and the flame and smoke which formed their columns were perfectly distinct from the general mass which arose from the fire. They appeared rather to increase in size and frequency toward the latter part of 'the burning,' and many were formed on the ashes, after the fire had, to a great extent, gone down.

" Among the whirlwinds there were several points of difference, by which they might be classed under four heads. The most common one was that which was stationary over a part of the fire which was hotter than the neighbouring portions. A second variety was that which had a progressive motion, and advanced over the burnt track, throwing up ashes and cinders, and thus marking its course through the fire. Some of these emerged from the flames. This was probably the case with quite a number, although, having nothing to mark them after leaving the fire, they became invisible. One, however, passed near enough to us to be observed, and attracted our attention by its rustling sound, and by the leaves which it carried up. This was about fifteen or twenty feet high. At the time this passed us, we had moved from our first station, and were about three hundred yards from the fire. These whirlwinds differed from the others in form, being very wide at the top, and contracting to a point at the bottom, like a top or a spindle, or, more exactly, they were of the form of the upper cone of an hour-glass. An interesting phenomenon which attended some of the whirlwinds might render it proper to arrange them under a third class. In these the flame was violently whirled at the base; then above succeeded a dark interval, where the flame seemed to be extinguished entirely, but towards the top it broke out anew. It was a mixed whirling of flame and smoke, the smoke occupying the central portion. The dark interval where the smoke was unconsumed was greater or less, as the flame above approached to, or receded from, that beneath. There were quite a number of this class. The fourth kind were formed of immense columns of smoke, so narrow and lofty that they resembled towers of several hundred feet, or trunks like those of trees in form, extending into the sky. The rotary motion was obvious throughout their entire length. These columns of smoke were generally straight, but sometimes bent at the top by the wind. In connection with the whirlwinds, there were several other facts of interest observed during the burning of the cane. We noticed the direction of the wind was changed. At first it was from the north-east, and continued in that direction in the upper part of the atmosphere, as was evident from the way in which the columns of smoke were bent. But shortly after the commencement of the burning, the air beneath blew in all directions towards the centre of the fire. The columns of smoke were not bent for more than a hundred yards; hence,

up to that height, the wind blew in all directions towards the centre of the fire. These whirlwinds revolved on their axes from right to left, and from left to right, without any prevailing tendency to one direction more than to the other. Frequently the same whirlwind would change the direction in which it revolved, and would again return to its first course. In a few instances, this was repeated several times. The charred leaves of cane, being thin and light, were driven off in considerable quantities. They were carried up, frequently, without being burned, and were sometimes found at a distance from the place of the fire. But, considering the extent of the fire, few cinders were carried up. The combustion was very complete."

CURIOUS EXPERIMENTS WITH SHOT.

A SERIES of experiments have been recently made at Portsmouth, under the direction of a government officer, which proved satisfactorily that shot could be made to take a considerable diverging course instead of going in a direct line to the object they were directed against, and that the result could be attained with great certainty by very simple means. The experiments were made with 32 and 68 pound shot, which were prepared for the purpose by having a hole bored on one side of about an inch and a half in diameter, which is afterwards filled with a plug made of wood. The extraction of the metal from one side of the shot alters the centre of gravity and the direction of the shot when fired, according as the wooden plugged side is placed upwards or downwards, or to the right or left, when loading the gun. The result of the experiments with 32-pound shot, plugged as described, showed that, with the usual service charge of gunpowder (10 pounds), with the plug placed to the right of the gun, and the piece of ordnance directed against a target in the usual way, the shot when fired diverged to the extent of fifty yards to the right of the target; and when the plug was placed to the left side of the gun, the divergence when fired was fifty yards to the left of the target. On placing the plugged side of the shot downwards in the gun, the shot when fired fell 400 yards short of the target; and when the plugged side of the shot was placed upwards in the gun, the shot when fired ranged beyond the target. Nearly the same result was obtained in a number of experiments. The experiments with the 68-pound shot, bored and plugged in a similar manner, gave more extraordinary results, as the plug when placed downwards in the gun fell 600 yards short of the object aimed at; and when the plug was placed upwards in the gun, it went 600 yards beyond it. When the plug was placed to the right, it diverged between 60 and 70 yards before it reached the distance of the target, and the same distance to the left when the plug was placed to the left. — *English paper.*

GEOMETRICAL PRINCIPLES OF BEAUTY.

AT the British Association, the following original views of Mr. Hay, celebrated for his work on colors, were presented: — That the

eye is capable of appreciating the exact subdivision of spaces, just as the ear is capable of appreciating the exact subdivisions of intervals of time; so that the division of space into an exact number of equal parts will affect the eye agreeably, in the same way that the division of the time of vibration in music into an exact number of equal parts agreeably affects the ear. But what spaces does the eye most readily divide? Mr. Hay supposes those spaces to be angles, not lines, believing that the eye is more affected by direction than by distance. According to his theory, bodies are agreeable to the eye, so far as symmetry is concerned, whenever the practical angles are exact submultiples of some common fundamental angle. We should, therefore, expect to find that spaces in which the prominent lines are horizontal and vertical will be agreeable to the eye when all the principal parallelograms fulfil the condition that the diagonals make with the side angles which are exact submultiples of one or of a few right angles. In applying this theory to the construction of the human figure, in which we should expect *a priori* the most perfect development of symmetric beauty, we find that not a single linear measure is employed in its construction. The line which shall represent the height of the figure being once assumed, every other line is determined by means of angles alone. For the female figure these angles are one half, one third, one fourth, one fifth, one sixth, one seventh, and one eighth of a right angle, and no others. It must be evident, therefore, that, admitting the supposition that the eye appreciates and approves of the equal division of space about a point, this figure is the most perfect which can be conceived. Every line makes with every other line a good angle. The male figure is constructed upon the female figure by altering most of the angles in the proportion of 9 to 8; the proportion which the ordinary flat seven bears to the tonic.

Mr. Russel said, that he was afraid that artists would not admit of such a mathematical definition of beauty as Mr. Hay was attempting to establish, yet all analogy proved that there was truth in the theory. A few centuries ago the philosopher would have laughed at the man who should have announced that the great irregular rocks of the earth, and the stones on the road, were all formed on mathematical principles, and yet every one now knew that such was the fact, and the science of mineralogy used these mathematical forms as the basis of classification; so in the plant and in the animal are frequently found such regular repetition of the same form, and such perfect obedience to mathematical principles, that it could not but be felt that one day we should be able to reduce all typical beauty to mathematical forms.
— *London Athenæum*, Aug.

CHEMICAL SCIENCE.

ARTIFICIAL PRODUCTION OF MINERALS.

ELIE DE BEAUMONT and DUFRENOY, in a report presented to the French Academy, April 1, state that M. Daubrée, having observed that the ores of tin are constantly accompanied by fluoric or boracic minerals, particularly mica, topaz, tourmaline, &c., was induced to believe that this circumstance was connected with the cause which produced the formation of the ores, and that the tin was brought into its beds in the state of fluoride, and there, undergoing a double decomposition, produced oxide of tin and fluoric minerals. He therefore endeavoured to produce, artificially, oxide of tin, by processes similar to the supposed ones of nature, making use, however, of the chloride instead of the fluoride. By passing through a porcelain tube heated to a white heat two currents, the one of the vapor of perchloride of tin, the other of steam, he obtained small crystals of the oxide of tin while the hydrochloric acid escaped in the form of vapor. The crystals were deposited upon the inside of the porcelain tube, not however throughout its whole length, but at the entrance, where the temperature was hardly 300° C., while the hottest portion contained none at all. At the end where the vapors escaped, the oxide of tin formed an amorphous concrete mass. The crystals adhered very strongly to the tube, insinuating themselves into the smallest interstices of the porcelain. They are very brilliant, and almost always colorless; they are infusible, and unattacked by acids, resembling in these particulars natural oxide of tin, but differing from it in crystallization, as they belong to the system of the right rhomboidal prism. Oxide of tin, therefore, admits the same dimorphism as oxide of titanium, with which it is isomorphous. These facts led M. Daubrée to suppose that he might also obtain crystals of oxide of titanium, in which endeavour he was successful, having produced crystals of Brookite. Chloride of silicium gave also by decomposition small crystals of quartz.*

* See *Annual of Scientific Discovery*, 1850, p. 212.

DISTRIBUTION OF SIMPLE BODIES IN NATURE.

M. ELIE DE BEAUMONT in an elaborate paper on "volcanic and metalliferous eruptions," published in the *Bibliothèque Universelle de Genève*, gives an interesting table of the distribution of the simple bodies in nature. The following is a brief summary of the memoir. The numbers refer to those in the table on the opposite page.

1. Bodies most generally spread over the surface of the globe, being sixteen in number. We may add titanium, bromine, iodine, and selenium, which are generally diffused in small quantities, thus raising the number to twenty, but of these only twelve are found frequently and in abundance. 2. Fourteen simple bodies which enter into the composition of various species of lavas produced by existing volcanoes. Of these, however, sulphur, hydrogen, chlorine, and fluorine occur in lavas only as exceptions, so that the number should be reduced to ten. 3. Fifteen simple bodies composing the ancient volcanic rocks. 4. Simple bodies entering into the composition of the *basic* rocks, or those whose mode of eruption has differed from that of volcanic rocks; such are the serpentines, traps, &c. 5. Simple bodies composing granites or acidiferous rocks, that is, those in which the bases are saturated with silica, such as quartziferous porphyry, granite, &c. 6. Simple bodies entering into the composition of stanniferous veins, or veins of substances which accompany tin. 7. Simple bodies of ordinary or plumbiferous veins and others, to which have been added the bodies that enter into the composition of the crystallized masses contained in the geodes of amygdaloids, in the fissures of septaria, &c. 8. The elements met with in mineral waters. This list is, so to speak, only an extract of the list of bodies which are found in ordinary veins. 9. Simple bodies found in the emanations of existing volcanoes. By comparing columns 2 and 9 with 5 and 6, we infer that the foci of active volcanoes are the poorest in simple bodies of those which have acted at the earth's surface. 10. Simple bodies found in a native state on the surface of the globe. Palladium, rhodium, ruthenium, iridium, and platinum do not form lasting combinations but among themselves, and appear to constitute a department by themselves in the midst of the mineralogical world. 11. Bodies found in aerolites, to the number of twenty-one, all of which are bodies already known at the surface of the globe, fifteen of them being included in the list of the sixteen most widely diffused simple bodies. 12. Bodies which enter most generally into the composition of organized bodies; they are the same as those occupying the first column, showing "that the surface of the globe contains in almost all its parts every thing essential to the existence of organized beings."

It is proper to say, that researches published since the preparation of the table would require some alterations and additions in it, while in regard to the distribution of some of the bodies enumerated, other geologists may entertain different views. — *Editors.*

Table of the Distribution of Simple Bodies in Nature.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
	Bodies most generally dis- tributed.	Modern Vol- canic Rocks.	Ancient Vol- canic Rocks.	Basic Rocks.	Granites.	Stanniferous Veins.	Ordinary Veins and Geodes.	Mineral Springs.	Volcanic Emanations.	Native Radicals.	Aerolites.	Organic Bodies.
1. Potassium,	*	*	*	*	*	*	*	*	*	*	*	*
2. Sodium,	*	*	*	*	*	*	*	*	*	*	*	*
3. Lithium,	.	.	.	.	.	.	.	.	.	.	.	.
4. Barium,	.	.	.	.	.	.	.	.	.	.	.	.
5. Strontium,	.	.	.	.	.	.	.	.	.	.	.	.
6. Calcium,	*	*	*	*	*	*	*	*	*	*	*	*
7. Magnesium,	*	*	*	*	*	*	*	*	*	*	*	*
8. Yttrium,	.	.	.	.	.	.	.	.	.	.	.	.
9. Glucinium,	.	.	.	.	.	.	.	.	.	.	.	.
10. Aluminum,	*	.	*	*	*	*	*	*	*	*	*	*
11. Zirconium,	.	.	.	.	.	.	.	.	.	.	.	.
12. Thorium,	.	.	.	.	.	.	.	.	.	.	.	.
13. Cerium,	.	.	.	.	.	.	.	.	.	.	.	.
14. Lanthanum,	.	.	.	.	.	.	.	.	.	.	.	.
15. Didymium,	.	.	.	.	.	.	.	.	.	.	.	.
16. Uranium,	.	.	.	.	.	.	.	.	.	.	.	.
17. Manganese,	*	*	*	*	*	*	*	*	*	*	*	*
18. Iron,	*	*	*	*	*	*	*	*	*	*	*	*
19. Nickel,	.	.	.	.	.	.	.	.	.	.	.	.
20. Cobalt,	.	.	.	*	*	*	*	.	*	.	*	.
21. Zinc,	.	.	.	*	*	*	*	.	*	.	*	.
22. Cadmium,	.	.	.	.	.	*	*	.	.	.	.	.
23. Tin,	.	.	.	.	*	*	*	.	.	.	.	.
24. Lead,	.	.	.	*	*	*	*	.	*	*	*	.
25. Bismuth,	.	.	.	*	*	*	*	.	*	*	*	.
26. Copper,	.	.	.	*	*	*	*	*	*	*	*	.
27. Mercury,	.	.	.	.	.	*	*	.	.	*	.	.
28. Silver,	.	.	.	*	?	*	*	.	.	*	.	.
29. Palladium,	.	.	.	*	*	*	*	.	.	*	.	.
30. Rhodium,	.	.	.	*	*	*	*	.	.	*	.	.
31. Ruthenium,	.	.	.	*	.	.	.	.	.	*	.	.
32. Iridium,	.	.	.	*	.	.	.	.	.	*	.	.
33. Platinum,	.	.	.	.	.	.	*	.	.	*	.	.
34. Osmium,	.	.	.	*	.	.	.	.	.	*	.	.
35. Gold,	.	.	.	*	*	*	*	.	.	*	.	.
36. Hydrogen,	*	*	*	*	*	*	*	*	*	.	*	*
37. Silicium,	*	*	*	*	*	*	*	*	*	.	*	*
38. Carbon,	*	.	.	*	*	*	*	*	*	*	*	*
39. Boron,	.	.	.	*	*	*	*	*	*	.	.	.
40. Titanium,	.	*	*	*	*	*	*	.	.	.	.	.
41. Tantalum,	.	.	.	*	*	*	*	.	.	.	.	.
42. Niobium,	.	.	.	*	*	*	*	.	.	.	.	.
43. Pelopium,	.	.	.	*	*	*	*	.	.	.	.	.
44. Tungsten,	.	.	.	*	*	*	*	.	.	.	.	.
45. Molybdenum,	.	.	.	*	*	*	*	.	.	.	.	.
46. Vanadium,	.	.	.	*	*	*	*	.	.	.	.	.
47. Chromium,	.	.	.	*	*	*	*	.	.	.	*	.
48. Tellurium,	.	.	.	*	*	*	*	.	.	*	.	.
49. Antimony,	.	.	.	*	*	*	*	.	.	*	.	.
50. Arsenic,	.	.	.	*	*	*	*	*	*	*	.	.
51. Phosphorus,	*	.	.	*	*	*	*	*	*	.	*	*
52. Nitrogen,	*	.	.	*	*	*	*	*	*	*	*	*
53. Selenium,	.	.	.	*	*	*	*	*	*	*	*	*
54. Sulphur,	*	*	*	*	*	*	*	*	*	*	*	*
55. Oxygen,	*	*	*	*	*	*	*	*	*	*	*	*
56. Iodine,	.	.	.	*	*	*	*	*	*	*	*	*
57. Bromine,	.	.	.	*	*	*	*	*	*	*	*	*
58. Chlorine,	*	*	*	*	*	*	*	*	*	.	*	*
59. Fluorine,	*	*	*	*	*	*	*	*	*	.	*	*
	16	14	15	30	42	48	43	24	19	20	21	15

ON THE FUSION AND VOLATILIZATION OF BODIES.

For some time past, M. Despretz, of Paris, has been actively engaged in a series of experiments, with a view of determining the effect of the application of an intense heat upon the nature of different substances. For this purpose, he has sought to combine the three most powerful sources of heat, the sun, the electric current, and combustion, and to apply them united at one point. To effect this, he employed a galvanic battery equal to 185 pairs, an annular lens nearly 90 centimetres (about a yard) in diameter, and a blowpipe of carburated hydrogen. By the addition of another source of heat the power of the battery was found to be so greatly increased, that hard and compact magnesia, which, under the action of the battery alone became pasty, immediately volatilized in the form of white vapor by the concurrent action of the battery and lens. Pure anthracite coal, subjected to the simultaneous action of the battery, lens, and blowpipe, appeared to fuse and fall in drops. Charcoal was also caused to fuse and volatilize. By the application of the electric fire alone, tungsten, boron, silicium, and titanium were readily fused, and the three latter volatilized. The tungsten, when fused, became so hard as to be polished only with diamond dust. This great hardness suggests its application for various useful purposes in the arts, as the cutting of precious stones, &c. By this same battery 80 grammes of palladium were instantly reduced to a beautiful button, and 250 grammes of platinum were reduced to a liquid in a few minutes. In fine, says M. Despretz, there is not a single metal which can resist the electric fire.

With a battery of 600 elements alone, charcoal has been so intensely heated, that an acicular rod has been seen to bend under the form of an arc of a circle, or even under the form of an S. The charcoal in this condition is almost always fused and partially converted into graphite. When two charcoal rods thus heated were pressed against one another, the positive rod penetrated into the negative charcoal to the depth of four or five millimetres. When the volatilization, which is effected by this battery, takes place, it is manifested under the form of a black cloud, which rises from the entire surface of the charcoal, and is deposited in great part upon the sides of the vessel in which the charcoal which unites the two poles of the battery is placed. In most of these cases the experiments were made in nitrogen, or some gas not supporting combustion, at a higher pressure than that of the atmosphere. The apparatus by which these conditions are fulfilled is of cast-iron, fitted with a movable cover, and thick glass plates, to afford a view of the interior. It contains, also, various arrangements inside, for supporting and connecting the various substances to be operated on. When it is desired to operate *in vacuo*, a large bell-glass receiver on the platinum of a pneumatic apparatus is substituted. A circular iron plate and a metallic grating defend the platinum and the glass against the projection of powerfully heated globules and sparks. In experiments in the open air, a box is used, open on the side of the battery, and closed on the side of the observer. An opening exists, fitted with blue glass. By these arrangements the danger of these

experiments, arising from electrical heat and light, as well as from the disengaged gases, is diminished. One cannot be too securely defended, however, especially from the electrical light, when it is raised to a certain degree of intensity. The light from 100 elements might occasion serious danger to the eyes; but this danger is much greater when the light from a battery of 600 elements is encountered. Even in approaching it only for an instant, there is danger of a violent headache and pain in the eyes, and the face, moreover, is burnt, as by a powerful *coup de soleil*. M. Despretz and his assistants have in the course of his experiments been powerfully affected by it, and now, although well protected, one person is not permitted to conduct a whole series of experiments.

In some of his experiments, M. Despretz joined to a Bunsen's battery of 600 elements another battery of 135 elements, directing the fire of the first battery directly upon the object, while it was heated by the other. Such was its intensity, that when a crucible made of retort charcoal, containing pieces of sugar charcoal, was submitted to its action, in an instant the sugar charcoal was consumed, the crucible reduced to bent fragments, and the whole converted into graphite. In this connection, Despretz mentions that acicular rods of retort charcoal may be converted into graphite by the heat of an enameller's lamp in the course of a few minutes, and this change sometimes even takes place in the retorts where it is produced. It is even probable that, after a sufficiently long time, the same transformation might be accomplished at a much lower temperature than that of the retorts in which gas for lighting is made. This fact, in a geological point of view, is interesting. The size of the pieces of charcoal fused by Despretz have in some instances exceeded that of a large pea.

Various experiments have been also made in connection with these powerful batteries upon the diamond. For this purpose, the diamonds, after having been heated gradually, to prevent a splitting when suddenly exposed to a high temperature, were inclosed in tubes of charcoal, seven or eight millimetres in external diameter, closed with charcoal stoppers. When exposed to a comparatively feeble action of the battery, the diamond changes color, becoming grayish-black, conducts electricity, has the appearance of graphite, or black-lead, and leaves a mark upon paper. The tube in this case was maintained at a white heat for twenty minutes. In a second experiment it was found that a diamond exposed to the same degree of heat for seventeen minutes did not experience much, if any, alteration, but still scratched glass, and was a non-conductor of electricity. A diamond of 2.5 millimetres in diameter, exposed to a stronger action of the battery, that of 600 elements, immediately fused, and when cooled could be crushed in the fingers. In another experiment, six small diamonds were exposed to the full strength of the battery for $7\frac{1}{2}$ minutes; two of the diamonds had then the appearance of graphite, and the remainder were reduced to dust. The change which the diamond was found to undergo on exposure to great heat was in general as follows. It first changes to charcoal, from a non-conducting to a conducting body, then to graphite, and, if the heat be sustained, it gives rise to small fused globules.

The result of the series of experiments so far as yet made public is thus summed up by Despretz in a communication to the French Academy. 1. Charcoal *in vacuo* is uniformly reduced to vapor at the temperature which it acquires from a Bunsen's battery of 500 to 600 elements, united in five or six series. In a gas it is slower, but it is likewise accomplished. 2. Charcoal by a proportionate temperature may be bent, fused, and welded. 3. Any kind of charcoal becomes so much the harder as it is submitted for a longer time to a high temperature. In fact, it is converted into graphite. 4. Pure graphite is gradually dissipated by heat, like charcoal. That which remains is graphite still. 5. The diamond is changed, by the heat of a sufficiently powerful battery, into graphite, like every other kind of charcoal. Like charcoal, it gives rise to small fused globules, when heated for a very long time. 6. If we compare the results of our experiments with the production of graphite in the high furnaces, from the hexahedral form of natural graphite, a form incompatible with the regular octohedron, we are inclined to think *that the diamond is not the product of the action of any intense heat upon organic or carbonaceous matters.* — *Comptes Rendus*, June 18, *et post*.

ON A PECULIAR FORM PRODUCED IN THE DIAMOND UNDER THE INFLUENCE OF THE VOLTAIC ARC.

MR. J. P. GASSIOT exhibited to the British Association, at its last meeting, a diamond which had been exposed to the intense heat produced by the voltaic battery when arranged as in the device for the electric light. The diamond had apparently been fused, but, instead of changing into coke, as in such circumstances diamonds generally do, it had become a glassy mass, and seemed to consist of a multitude of small crystals adhering to each other. When the diamond is converted by galvanic fusion into coke, it changes from a non-conductor to a conductor; in this case the diamond, though fused, still remained a non-conductor.

At the same meeting, Mr. H. C. Sorby read a paper on "the trimorphism of carbon," the object of which was to establish the fact that coke was in reality crystallized when very hard, and in the same form as the diamond, from which, however, it was stated to differ in crystallographic volume. Mr. Sorby stated that he had also observed anthracite coal in the form of crystals belonging to the square prismatic system. — *Jameson's Journal*, Oct.

THE NEW METAL, ARIDIUM.

A PAPER by M. Ullgren has been recently communicated to the Academy of Sciences at Stockholm, giving an account of a supposed new metal occurring in the chrome-iron of Rösos, and some other iron ores. As the metal exhibits in its oxides great resemblance to iron, it has been called *Aridium*. In some experiments made with a view of detecting the presence of phosphorus in the bar-iron of the Oernstol iron ores, the author found that the solution of iron obtained be-

haved in several respects differently towards reagents from one of iron only. Subsequently, in an examination of the chrome-iron of Rösos, he found that the peroxide of iron separated from it behaved like that in the first-named solution. This, upon a careful and lengthened examination, was found to be owing to the presence of the substance which has been denominated *Aridium*. M. Ullgren has obtained it in the form of a sulphate of the peroxide in small crystals, and also as a lower oxide. These oxides show considerable analogy to those of iron, but may be distinguished from it by various reactions. A solution of the peroxide of aridium gives a dark blue precipitate with ferrocyanide of potassium; but an excess of this precipitant changes the color into a dirty bluish-green. It dissolves in hydrochloric acid without disengagement of chlorine, and furnishes, on evaporation at a gentle heat, a lemon-colored deliquescent residue, which cannot be made to crystallize. It differs in this respect from the oxides of iron and cerium. With carbonate of soda it gives a light brownish-yellow precipitate, with a yellow solution; peroxide of iron, on the contrary, gives a brownish-red precipitate, which also dissolves with a red color. When hydrosulphuric acid was passed through a solution of the metal, the oxide was reduced to protoxide. After expelling the excess of hydrosulphuric acid, it was precipitated of a grayish-white color by ammonia; but this precipitate at once became a light brown, without passing from green into brown, as in the protoxide of iron. Before the blowpipe, oxide of aridium gives, with borax, on platinum wire, in the outer flame, a yellow bead, which becomes colorless on cooling with small quantities. In larger quantities this bead is of a brownish-red; on cooling, yellow and opalescent. In the inner flame the bead is colored of a light green by small quantities, and becomes colorless on cooling; with a large quantity the bead is of a beautiful green while hot, but the purity of the color decreases as it cools. Metallic aridium has not yet been obtained. — *London Chemist, Sept.*

TITANIUM.

It is well known that Prof. Wöhler, of Germany, has within a recent period ascertained that the beautiful copper-colored crystals of titanium, so often observed in blast-iron furnaces, are not, as has been generally believed, simple bodies, but compounds, made up of the metal titanium and that most unstable of all bodies, nitrogen. The following additional particulars respecting this compound have been communicated by Prof. Wöhler to a society in Göttingen: — The crystals are composed of cyanide of titanium, mixed with nitride of titanium, and contain in 100 parts, titanium 78.00, nitrogen 18.1, carbon 3.89; that is, they consist of cyanide of titanium 16.21, nitride of titanium 83.72. When these crystals are heated in dry chlorine gas, liquid chloride of titanium is produced, and at the same time a crystalline volatile yellow substance sublimes in considerable quantities. This latter product is a compound of chloride of titanium with chloride of cyanogen. At the end of the operation, about one per

cent. of residue remains behind, which is graphite in fine scales. Again, when the crystals are powdered, mixed with hydrate of potash and fused, ammonia and titanate of potash are formed. When the crystals are heated to redness in a porcelain tube, and steam is passed over them, a considerable quantity of hydrogen gas is liberated, together with a disengagement at the same time of ammonia and hydrocyanic acid. With regard to the formation of the crystals in the smelting furnace, Wöhler believes that it stands in intimate connection with the formation of cyanide of potassium; and experiments fully confirm the supposition. A mixture of ferrocyanide of potassium and titanous acid was exposed in a well-closed crucible, for an hour, to a heat at which nickel would melt. The result was a brown unfused mass, which, under a magnifying power of 300 diameters, presented, besides the particles of metallic iron throughout the whole mass, a net-work of copper-colored, strongly metallic, shining, short prisms, which, as indicated by the color, are composed of the same substance before examined. The titanium used in all these experiments was produced in a furnace in the Hartz, where lately a mass of titanium has been found, estimated at 80 lbs. (Hanover) weight. Prof. Wöhler has also ascertained, that the crystals obtained by Rose from the double chloride of titanium and ammonia, by subjecting the same to the action of heat in gaseous ammonia, are not pure metallic titanium, as was supposed, but a nitride of titanium, containing nearly 28 per cent. of nitrogen. But this is not the only isolated compound of nitrogen and titanium, two other compounds having been found to exist. All these compounds possess the remarkable property, if mixed with oxides of lead, copper, or mercury, and heated, of emitting a lively, sparkling flame and reducing the oxides of these metals. All of these compounds, moreover, can sustain a temperature at least equal to that at which silver would melt, without undergoing decomposition.

In conclusion, Prof. Wöhler answers the question, What is the character of pure titanium? This substance was first observed by Berzelius; it was not, however, closely examined by him. It is that body which is produced by heating the double fluoride of potassium and titanium with potassium. After washing and separation by water, pure titanium remains behind, as a dark, green, uncrystalline, and tolerably heavy powder. Even after being subjected to pressure, one cannot discern a shade of color approaching that of copper, and under the microscope it appears as a cemented mass, having the color and lustre of iron. If heated in contact with the air, it burns with much splendor; sprinkled into a flame, it burns at a considerable distance above its point, with a splendor resembling a discharge of the electric fluid. Its comportment in chlorine gas is very similar, requiring also, however, the aid of heat; mixed with minium and heated, it burns with such an intense evolution of caloric, that the mass is thrown out with a report. Titanium possesses the property of decomposing water; at a temperature of 212° F., in pure water, hydrogen gas begins to be evolved, and in warm hydrochloric acid it is dissolved with a brisk disengagement of hydrogen. Ammonia throws down from the solution a black oxide; if the liquid be then

warmed, a disengagement of hydrogen takes place, the oxide becomes first blue, and is afterwards transformed into white titanitic acid.

ON THE STRUCTURE OF LAKE SUPERIOR COPPER.

At a meeting of the American Academy, in January, Dr. A. A. Hayes stated, that, from extended observations, embracing more than five hundred specimens of the Lake Superior native copper, no instance occurred in which the slightest indication was presented of this copper having been fused in its present condition. He had investigated its internal structure, by a new method of analysis, which permits all alloys and foreign matters to fall on one side, while the pure copper is separated and weighed as such on the other. In this way, and by little modifications, the highly crystallized structure is exposed to view, the less regularly polarized portions being removed. Whether we subject the solid thick masses, or the thinnest plates, to the operation, one constant result is obtained; — *that this copper has taken its present varied forms of crystallized masses, more or less flattened, laminated, or grooved, by the movement among the parts composing the rocks in which it is found.* If we select a mass which has entered a cavity, we find the crystals with their angles sharp and uninjured, while the mass mainly may have been compressed into a plate. Dissecting this, the crystals are seen to be connected with and form parts of the original system of crystallization. Flattened and grooved specimens often present on their edges arrow-head-shaped forms, derived from regular crystals, crushed and laminated.

PROCESS FOR REFINING GOLD.

PROF. JAMES C. BOOTH has patented an improvement in processes for refining gold, which is thus described in his specification. "The nature of my invention consists in the preparation of a solution of gold, alloyed with silver or other metals, so as to convert them into chlorides; and a precipitation of metallic gold upon the chloride of silver and other insoluble chlorides; and in the subsequent reduction and extraction of the silver or other metals from those insoluble chlorides; or the direct extraction of their chlorides by solution in the manner hereinafter set forth, so as to leave the gold pure." Among the claims is one for the process of dissolving alloyed gold for refining it, by developing nitric acid, or both nitric and muriatic acids, gradually from their salts, in the manner set forth.

SILVER IN METALLIC MINERALS AND THE PROCESSES FOR ITS EXTRACTION.

MESSRS. MALAGUTI and DUROCHER presented to the French Academy, on Dec. 10, 1849, papers giving an account of some very careful examinations made by them on the association of silver with the metallic minerals and the best process for its extraction. They commence by referring to some previous researches upon the metallic sul-

phurets, and then remark, "We have extended our investigations to other metallic minerals, and can now assert that nearly all of them contain silver, even when they do not come from strata from which this mineral is extracted; for of over two hundred substances examined, in only a twentieth part of the trials have we failed to detect silver." The investigation has been pursued with extraordinary care,—among other precautions, the purity of the reagents used being carefully determined. In some experiments made upon the roasting of different sulphurets, it was found that the silver contained in the blendes often undergoes a loss, by sublimation, of more than half. It is found that, notwithstanding all the precaution taken, a considerable portion of the silver is always lost by clinging to the vessel, so that it cannot be removed. Silver is unequally diffused in the different metallic substances; thus the oxides and the saline combinations always contain less than the sulphurets, and among these latter those having a base of iron are generally less rich in silver than those having a base of lead, copper, or zinc. The general diffusion of silver in the mineral kingdom induces the belief that other metals may be equally diffused, and on examination of twelve specimens of galena, there were found, besides silver, very perceptible quantities of iron, copper, and zinc.

From various experiments upon the condition under which silver is associated in small quantities with different metallic minerals, the authors conclude that "silver is not found in the same form in all the sulphurets containing small quantities of it, but that it seems most often to be combined as a sulphuret with the substance which it accompanies." It has also been demonstrated that the metallic sulphurets cannot contain silver in the form of chloride and bromide, and some remarkable reactions have been observed between the chlorides and the sulphurets. The sulphurets of zinc, cadmium, lead, &c., react upon the chloride of silver by double decomposition; those possessing many particles of sulphur, which they can abandon, such as the bisulphuret of tin, undergo a partial reduction and are changed into protosulphurets; and those not saturated with sulphur and capable of absorbing it partly reduce the chloride of silver and also act upon it by double decomposition. The power of the sulphurets of decomposing the chloride of silver is more marked in those which act by reduction than in those that produce a double decomposition; this power appears to have some relation to the electro-chemical state of the metals. The bromide of silver exhibits the same phenomena of decomposition as the chloride, and all these facts appear to depend upon a general law of the reaction of the sulphurets upon the chlorides, and the insoluble upon the soluble salts. These reactions take place in the dry as well as in the humid way; thus galena decomposes fused chloride of silver.

In spite of the attention which has been paid to the amalgamation of silver ores, there yet remain many obscure points, upon some of which the authors think their experiments throw some light. The matrix which accompanies the ores plays an important part; the clayey or argillaceous gangues are the worst, and the quartzose, or, in general, those which have the least tendency to make a paste with water, are the best. The proper quantity of water to be added is just sufficient to

bring the ore to a semi-liquid paste. The presence of different salts, especially sea-salt, assists the reduction of the chloride of silver, but the carbonate of lime hinders it.

In nearly all the processes of amalgamation, the first operation consists in changing to a chloride the sulphuret of silver, after which the chloride must be reduced, so that a considerable portion of the mercury is lost. This, with other considerations, prompted the authors to search for a process by which the sulphuret of silver might be directly reduced without changing it into a chloride. The reagent which they consider the most effective is metallic copper used at the temperature of boiling water, and associated with certain salts, sulphates of copper, iron, or alum. A process newly introduced, which dissolves the chloride of silver into a concentrated solution of sea-salt, offers many advantages, among others the avoiding the use of the costly reagent mercury, and if there are no practical difficulties in the way, the general employment of this method would cause a large increase in the production of silver.

METALS IN SEA-WATER.

In continuation of the researches mentioned above, Messrs. Malaguti and Durocher, in company with M. Sarzeaud, have made a series of experiments to discover if silver and other metals occur in sea-water. Water taken some leagues off the coast of St. Malo was found to contain a little more than $\frac{1}{100,000,000}$ of silver, while the ashes of the fucoid al plants *serratus* and *ceramoides* contained $\frac{1}{100,000}$. They have also detected silver in sea-salt, in common hydrochloric acid, and in the soda of commerce, as well as in the rock-salt of Lorraine. Pursuing their investigations, they have obtained such indications as leave no doubt of the existence of silver in vegetable tissues and in the blood of cattle. In the ashes of pit-coal, silver has not been clearly detected. Although lead and copper have not been directly detected in sea-water, the existence of about $\frac{18}{1,000,000}$ of lead and a small quantity of copper in the ashes of various species of *Fucus* has been clearly established.

POISONOUS EFFECTS OF ZINC.

It is now some time since it was proposed by M. Leclaire of Paris to use oxide of zinc as a substitute for white lead, with a view to avoiding the dangerous effects of the latter on the workmen. There could be little doubt that, in point of salubrity, oxide of zinc was an improvement on carbonate of lead; but it was still a matter worth determining to what extent the oxide of zinc was itself free from objection, and whether or not some precautions were necessary regarding its use. M. Flandin endeavoured to determine this experimentally. He rubbed animals over with ointment of oxide of zinc, of carbonate of lead, and sulphate of lead; and whilst he found that the two last always produced poisonous effects, he observed that the animals rubbed over with oxide of zinc continued to enjoy their usual health. Cases have, however, occurred, which show that the innocuousness of oxide of zinc

must not be admitted so decidedly as Flandin supposes. In the *Comptes Rendus* for May a case of undoubted metallic colic, occurring at one of the Paris hospitals, is described. The patient was a workman in the zinc paint-works, and the attack he experienced was of a very serious nature. By washing the surface of the body of this person, metallic particles were obtained, which afterwards were proved to be zinc. Workmen engaged in the manufacture and handling of galvanized iron wire (iron wire coated with zinc) have also experienced similar effects, though not so severe in their nature. Suspension of the work always caused a relaxation of the complaint. It does not appear, says Dr. Bouvier, in commenting on these cases, that oxide of zinc is as noxious as lead, but it shows, at least, that some precautions should be taken by those who work in it in order to preserve their health.

MANUFACTURE OF ZINC PAINTS IN NEW JERSEY.

It is well known that extensive operations have been entered into at Sterling, Sussex Co., New Jersey, with a view of manufacturing on a large scale the oxide of zinc from the celebrated red zinc ore which occurs abundantly at that locality. The process by which the oxide of zinc is prepared is exceedingly interesting. The mineral consists of oxide of iron, manganese, and oxide of zinc, or oxide of zinc and Franklinite. The ore is first roasted, and the Franklinite picked out. It is then pulverized and mixed with a small proportion of anthracite or charcoal as a flux; and about forty pounds is used as a charge for a cylindrical retort made of clay, three and a half feet in length, and eight inches in diameter. The retort is placed in a reverberatory furnace horizontally, one end being exposed by an opening in the furnace wall: a sheet-iron receiver is attached to the mouth of the retort, having an opening at the neck to admit atmospheric air. The receiver is elongated by flexible tubes that serve as additional receivers, and also to carry off the carbonic oxide. When the proper heat is applied, the zinc is set free from the ore, and conveyed into the receiver as a vapor of zinc, where, meeting the current of atmospheric air, from which it takes up the oxygen, it falls at once as a beautiful powder of pearly whiteness. The metallic zinc is made in the same manner, with the exception that in the latter case the air necessary to form the oxide is entirely excluded.

The demand for the oxide of zinc at present is greater than the supply, and the company are constantly enlarging their works. It is used extensively as a substitute for white-lead in the manufacture of India-rubber goods, but its chief value is as paint. In France it has to a great extent taken the place of lead paints, and is being rapidly introduced in the United States. The advantages of zinc as a paint over white lead, in addition to the comparative security of the workmen from disease, are, that the action of gases will not change it, while lead paint is turned black by sulphuretted hydrogen; it is perfectly and dazzling white. It gives to a wall the lustre of porcelain, and may be washed without risk. It is ground in spirits of turpentine,

and mixed with varnish to give it a body and consistency. The red oxide of zinc also makes an excellent, quickly drying red paint. By adding lamp-black, Prussian blue, and other colors, any shade of paint may be readily obtained, free from the disadvantages of lead.

OCCURRENCE OF ARSENIC IN IRON PYRITES.

BREITHAUPt has examined a vast number of iron pyrites for arsenic, which metal he finds to be most extensively diffused, forming in general from $\frac{1}{2}$ to 1 per cent. It is probable that all the iron pyrites upon heavy spar and fluor spar contain arsenic. — *Pogg. Annalen*, Vol. LXXVII. p. 141.

ARTIFICIAL CRYSTALS OF SESQUIOXIDE OF CHROMIUM.

At the meeting of the American Association, at New Haven, Mr. Blake called the attention of the members to some artificial crystals of sesquioxide of chromium, formed between the cracks of the floor of a furnace used for the production of chromate of potassa from the mineral chromate of iron. The furnace had been in operation for more than a year, and kept at a temperature above redness. The crystals have the hardness of sapphire, and resemble crystals of specular iron. Their lustre is metallic, color black. Wöhler obtained crystals of sesquioxide of chromium by passing the vapor of chlorochromic acid through a tube heated to redness. — *Silliman's Journal*, Nov.

NEW METHOD OF DETERMINING URANIUM IN ITS ORES.

A WEIGHED quantity of the ore is dissolved in nitric acid, filtered from the residuum, and then saturated with an excess of carbonate of potash, whereby the uranium remains in solution as neutral uranate of potash, with arsenic and sulphuric acids, when these are present. All the other metals in combination are precipitated as carbonates and separated by filtering. The soluble neutral uranate of potash is then boiled in a gilt silver vessel, whereby acid uranate of potash is formed, which is insoluble in water, is easily washed, and from which the quantity of uranium can easily be determined. — *Journal of Franklin Institute*, June.

CHEMICAL CONSTITUENTS OF IRON.

In the evidence given before the commissioners appointed to inquire into the application of iron to railway structures, as reported in the *Civil Engineer and Architect's Journal* for February, we find some interesting facts. The strength of cast-iron depends upon its freedom from impurities and upon the proportion of carbon it contains, the strongest containing about three per cent., or, according to Mr. C. May, when the carbon is in the smallest proportion that produces fluidity, a larger proportion tends to make the iron soft and weak, and a smaller hard and brittle. Mr. Glynn says that the strongest iron

generally shows a clear gray, or slightly mottled fracture. Mr. Stirling considers that, while color is admissible as a test of strength, it is not so of chemical constitution. The fluidity of Berlin iron is due to the presence of arsenic. Manganese mixed artificially with cast-iron closes the grain, and is an improvement to that as well as to steel. Manganese in wrought-iron gives it the hot-short property, whilst the cold-short is produced by phosphorus; the admixture of arsenic renders wrought-iron hard and brittle.

EXISTENCE OF IODINE IN FRESH-WATER PLANTS.

MÜLLER some time since discovered iodine in the water-cress, and the confirmation of this, in respect to this plant growing near Paris, convinced M. Chatin that this body is not, as is usually thought, confined to the zone of saline waters or mineral springs. He first examined various other species of *Cruciferae*, under the idea that most of these might contain it as they do sulphur and nitrogen; but the only one in which he detected it was another aquatic, the *Nasturtium amphibium*. He then turned his attention to the fresh-water aquatics, and, with some modifications in its mode of existence, found it present in an immense number of plants. Some of the results of the investigation are thus stated:—Iodine exists in all aquatic plants, while it is absent, or at all events cannot be detected, in terrestrial plants. Plants living in running waters, or in large masses of water capable of agitation by the winds, contain more iodine than do those in stagnant water. It is found also, though in small quantity, in those plants which are only imperfectly immersed in water, or during only a portion of their lives. The same plants which contain iodine when growing in water do not contain it if developed out of it. The proportion of iodine in plants is in general independent of their nature, and solely subordinate to their *habitat*, as shown by the *Confervæ*, *Nymphaeæ*, *Ranunculi*, &c., which are all equally rich in iodine in running waters, and all equally poor in ponds and marshes. An examination of the juices of these plants, and of their parenchyma, proved that the iodine existed exclusively in the former, and therefore as a soluble iodide. In answer to the questions, why land plants are destitute of it, and why it varies so greatly in the fresh-water ones, it may be observed, that iodine can scarcely exist in appreciable quantities in the small quantity of water that gains access to terrestrial plants; and the different position of the aquatic ones, in respect to soils, &c., which may contain it, will account in some measure for the variations. As iodine is found, not only in the plants growing in large rivers, but in those of every rivulet, pond, and marsh, it is impossible that it can be derived from any mineral spring, but must be widely diffused over the earth, accompanying like a satellite the chlorides, with which it is extracted by the water. Among the plants analyzed by M. Chatin, and on which are founded the previous results, are enumerated the cabbage, the horseradish, and the radish, terrestrial *Cruciferae* which contain no iodine, and various aquatic plants which contain more or less iodine, the cress, *Confervæ*, *Charafetida*, *Sagittaria*, *Potamogeton*, *Ranunculus aquatilis*, and many others. — *Comptes Rendus*, March 52.

Iodine and Bromine in Coal.—Recent examinations made by M. Bussy, and presented by him to the Paris Academy, show that iodine exists in coal in considerable quantity. He had detected it in the vapors given off during the slow combustion of coal caused by the decomposition of sulphuret of iron, and also in the ammoniacal liquor formed by the distillation of coal in gas-works. In this latter case the iodine was in sufficient quantities to admit of separation and estimation. Three kilogrammes of condensed liquor yielded 0.59 grammes of iodine. The coal from which the iodine was derived was obtained in Commentry, France; but as it has also been detected in other gas-works, it is probable that it exists in all varieties of coal. M. Bussy remarks, that the quantity of iodine obtained does not include the whole amount contained in the coal, since a quantity remains in the coke, which may be obtained by incineration. The distilled products of gas-works may thus possibly be employed for the economical preparation of iodine.

Since the above discovery of M. Bussy, M. Mené, another French chemist, has detected bromine, as well as iodine, in the ammoniacal liquor obtained as above mentioned.—*L'Institut*, No. 853. *Phil. Mag.*, Oct.

Mr. Storer, of the Lawrence Scientific School, has also, during the past year, detected the presence of iodine in the liquor resulting from the purification of coal-gas at the Boston gas-works. Bromine, though searched for, was not found.—*Editors*.

Iodine in Beet-Root.—M. Lamy has ascertained the presence of iodine in the beet-root of the Grand Duchy of Baden. As other specimens of beet-root examined by him contained no trace of iodine, he inquires, without attempting to decide, whether the presence of iodine may not be derived from the assimilation of the salts of this element, which are known to be common in the salt springs of Germany.

THE GENERAL DISTRIBUTION OF IODINE.

THE existence of iodine in certain aquatic plants, from all quarters of the globe, is evidence of the general distribution of this substance throughout the mass of the earth, and in its waters, both salt and fresh. The state of the earth at the periods of the old vegetation might be deduced from the proportion of iodine in their fossil remains. Coal, which is rich in iodine, must arise from plants developed on lands still washed by the sea; in anthracite, which contains less iodine than bituminous coal, we find that terrestrial vegetables have become mixed with the cryptogamic plants of the coal mines; and the lignites, which contain little or no iodine, show that the terrestrial species then predominate over the crust of the globe. Iodine appears in the lixivium of turfs; and its abundance in graphite seems finally to show that this substance should be classed among products of organic and aqueous origin. Anterior to the coal formation, graphite would represent the oldest vegetation of the globe. Fresh-water animals contain iodine; they even contain more than the plants which grow in the same water. From numerous experiments, it may be presumed that iodine exists in

variable proportions in all the waters of the globe. The richness of waters in iodine may be presumed according to the more or less ferruginous nature of the lands they wash. The proportion of iodine ordinarily increases in water with that of iron, so that waters which are called ferruginous might just as properly be called ioduretted waters. Waters of igneous earths are more ioduretted on the average, and especially more uniformly, than those of sedimentary earths. Though rich in iodine, the waters of the coal formation come after those of certain igneous earths, or ferruginous sediment. The waters of essentially calcareous and magnesian earths contain very little iodine. Iodides are not necessarily proportional to the chlorides. Waters of rivers are, on an average, more ioduretted and less charged with earthy salts than those of springs; the waters of wells, however, are at once most calco-magnesian and least ioduretted. The proportion which exists between the iron and the iodine of waters, the easy decomposition of the iodide of iron, and the complete decomposition of the iodide of the waters in evaporation without the addition of potassa, render it probable that the iodine exists in them as iodide of iron. Fermented liquors contain iodine; wine, cider, and perry are more ioduretted than the average of fresh waters. Milk is richer in iodine than wine; independently of the soil, with which it varies, the proportion of iodine in milk is in the inverse ratio of the abundance of that secretion. Eggs (not the shell) contain much iodine. A fowl's egg weighing 50 gr. contains more iodine than a quart of cow's milk. Iodine exists in arable land. It is abundant in sulphur, iron, and manganese ores, and sulphuret of mercury; but rare in gypsum, chalk, calcareous and silicious earths. Any attempt to extract iodine economically should be made with the plants of the ferro-ioduretted fresh waters. Most of the bodies regarded by therapeutists as pectoral and anti-scorfulous are rich in iodine.—*Chatin in the Comptes Rendus, Aug.*

Iodine in Aluminous Schists.—Some years ago M. Forchhammer brought forward an ingenious idea respecting the part which the species of *Fucus* take in the formation of aluminous schists. It consisted in admitting that the *Fuci*, after having accumulated in their substance the sulphates contained in sea-water, converted by putrefaction after death the sulphate of potash into sulphuret of potassium; this in turn precipitated the iron contained in the sea-water in the state of sulphuret of iron, which became mixed with the clay and other substances, some of which are organic, and owe their presence to the putrefaction of the *Fuci*. Chemical analysis, by demonstrating the presence of iodine in aluminous schists, added a new and powerful argument in favor of this hypothesis. The ash of the *Fuci* contains, in fact, a considerable quantity of iodine, which might lead to the supposition that this substance would be also found, at all events in small quantity, in these deposits, if the *Fuci* really take that part in the formation of these schists which M. Forchhammer attributes. Now M. Genteles, while engaged in some researches upon the manufacture of alum, has isolated iodine from the aluminous schists of Latorp, in Sweden. This discovery, joined to that of Duflos, of the presence of

iodine and bromine in the coals of Silesia, will suffice to draw the attention of geologists to the confirmation which they furnish of the ideas of M. Forchhammer respecting the formation of the aluminous schists. — *Svanberg's Jahresbericht*.

ON A DIRECT METHOD OF OBTAINING IODINE FROM CERTAIN SPECIES OF SEA-WEED ON A LARGE SCALE, WITH A MODE OF PROCURING IT AS A SUBSIDIARY PRODUCT ADAPTED TO COAST FARMS.

THE following is a summary of a research on the above subject, made in the Isle of Man, by Dr. George Kemp, the principles of which are applicable to all localities similarly situated. Marine vegetables on all sea-coasts may be classified according to the depths at which they are found, but for the present purpose it will be merely necessary to include them under two general classes, the shallow and deep water sea-weeds; the former embracing such growths as flourish between high and low water-mark, and the latter such as are principally found from low-water-mark to the depth of three or four fathoms. As the general result of analysis it may be stated, that the metallic base preponderating in the *Fuci*, or plants of the first class, is sodium combined with chlorine, and small quantities of iodine and bromine; whilst the plants of the latter class, or those which flourish in what Professor Forbes has denominated the Laminarian region, are characterized by containing a preponderating quantity of potassium, with a far larger proportion of iodine than in the former species, and on this account are of more interest and importance to the manufacturer. In the earlier periods of the growth of the sea-weed, iodine is almost entirely absent; it increases, however, with the advance of the plant, and reaches its maximum at the precise period when the plant yields to the autumn tempests and is drifted on shore, thus saving the expense and risk of collecting from the rocks. The present method of extracting iodine is by what is called the "kelp process," which consists in burning the weeds, lixiviating the ashes, and collecting the iodine from the mother-liquor by precipitation or distillation. To this plan there are many objections, arising chiefly from the difficulty in drying the weeds without inducing decomposition, from the tendency of the iodine to volatilize during combustion, and from the loss in the collection from the mother-liquor. To discover a better process was the object of Dr. Kemp. By examining a section of the stem of the *Laminaria digitata*, a species growing in deep water, he found that the iodine was enveloped in cells situated between an external thin cortical layer and a medullary central portion of the stem. This was an important discovery, and hopes were entertained at first that the iodine would be entirely liberated with a liquor yielded on subjecting the plant to pressure; but so condensed was the cellular tissue found, that it gave up, when subjected to great pressure, but comparatively little fluid. It was therefore determined, as the next experiment, to break up the cellular tissue as completely as possible, by rubbing the stem on an ordinary domestic grater. The result was perfectly satis-

factory, the iodine being liberated by ordinary chemical operations with the greatest ease. In repeating the process on a large scale, the weeds were cut fine with a vegetable-cutter, and the slices left in a heap for about twelve hours; a species of fermentation then commences, which reduces the whole mass to a pulp, which on the application of an adequate pressure yields a liquor containing the principal portion of the iodine. With reference to another species of sea-weed, the *Laminaria saccharina*, which in the autumn is very rich in iodine, the plan of extraction is still more simple. Having collected this as drift-weed, it is only necessary to heap it up in vats with a tap at the bottom to allow the draining liquid to escape. For some hours nothing but sea-water runs off; but at a certain stage, dependent mainly upon temperature and quantity, fermentation sets in, and iodine makes its appearance in the liquid. When this is ascertained by testing, the tap should be closed, and the mass suffered to remain for twelve hours, being occasionally stirred. When the contents of the vat have been reduced to a soft pultaceous magma, in which all the remaining cellular tissue can be readily broken down by the hand, the addition of quicklime, varying with the amount of substance operated upon, and which may easily be determined by experience, completes the process. The iodides in solution may then be removed by expression.

The subsequent steps of the operation will be much influenced by circumstances. If the object be merely to save the iodine, a variety of methods may be adopted to effect this purpose, one of which will be mentioned hereafter. If, on the other hand, it be a consideration to obtain the potash salts, evaporation, and probably repeated crystallizations, must be resorted to; and the facility of obtaining fuel at little expense will of course become an important element for consideration. It will, however, at once occur, that the cellular tissue which remains after pressure will render important service in this case; at all events but little experience and ingenuity will be required for combining all the favorable circumstances in such a manner as to insure a profitable arrangement. Whilst the use of iodine remains a matter of importance only in a pharmaceutical point of view, the demand must necessarily be limited, and such a supply as could easily be obtained by the above method would materially affect the market. Should any means, however, be discovered of rendering it useful for the purposes of dyeing, the application of sufficient capital would doubtless be attended with very profitable results. The complete separation of iodine from its solutions, Dr. Kemp has found to be best effected by an insoluble compound of starch with oxide of lead, which is formed by adding common starch to a solution of neutral acetate of lead and ammonia. By means of this mixture, any quantity of iodine may be precipitated from a solution, and by taking advantage of the weight and denseness of the precipitate, we can decant the supernatant liquid, and repeatedly wash the residue without loss.

The course proper to be adopted by the agriculturalist, in making a practical application of the facts above stated, is simply this. The sea-weed, being collected in heaps, may be suffered to drain itself of

the sea-water mechanically retained about it. As this will occupy some hours, the time may be employed by women and children in trimming the stalks of the tangle (*Laminaria digitata*) of leaves and roots, and arranging them in readiness for the cutter. The whole of the remainder may then be transferred into old hogsheads, in a sheltered spot near the beach, and allowed to ferment. The succeeding operations have been described. A quantity of the liquid is now assumed to have been collected, to which is added commercial hydrochloric acid, until a very marked acid reaction is obtained; a solution of ordinary chlorinated lime is then added to disengage the iodine, taking especial care not to use an excess. A very little practice will decide the quantity necessary, as the brown color of the liquid will increase up to a certain point, and the smallest addition of chlorine, when this has been attained, will diminish its intensity. Having thus liberated the iodine, it is precipitated with the prepared starch and lead diffused through water, continuing its addition until it is no longer rendered blue by the iodine. The remainder of the process consists in decanting the fluid portion, and straining the residuum, which, when dry, will be immediately available to the iodine manufacturer, and from which the iodide of potassium may be formed by the addition of sulphuret of potassium, or other appropriate means. The fluid portion, being rich in potash, soda, and magnesian salts, will form a most important contribution to the liquid manure tank, or may be thrown over the compost of the farm-yard, with the additional advantage of fixing the ammonia through its excess of hydrochloric acid. The tissues of the sea-weeds remaining after the extraction of the liquor can, when dry, be profitably used as fuel, and from the ashes various salts may be extracted by lixiviation. — *London Chemical Gazette*, July 1.

We see no reason why this discovery may not be immediately turned to a practical account in this country, as it doubtless will be in Europe. The plants referred to occur in considerable abundance upon the coast of the United States, one of the species being generally known under the name of the Devil's apron. — *Editors*.

NEW TEST FOR IODINE.

MR. CHARLES WATT communicates to the *London Chemist*, for January, a new test for the detection of iodine. He says, "to test for the presence of iodine it will be sufficient to fuse a small piece of chloride of zinc in a test-tube, having added a small quantity of manganese, and to drop the substance we wish to examine into it, when, if an iodide be present, iodine will be rendered evident by the color of its vapor, or by its action on a piece of paper dipped in starch. So delicate is this method of testing the presence of iodine, that, by adding one drop of a solution of iodide of potassium, containing one grain in an ounce, I could, by the color of the vapor, easily recognize the presence of iodine."

MELSENS'S PROCESS FOR THE MANUFACTURE OF SUGAR.

THE French Minister of Agriculture, during the early part of the past year, despatched M. Guiet to the French Colonies, to observe and experiment upon the celebrated process proposed by M. Melsens for the manufacture of sugar. The first report is dated at Guadaloupe, 26 April, a synopsis of which is given in the *London Patent Journal*. Up to the period indicated, M. Guiet had made but few experiments, and those not under favorable circumstances; the results, however, were such as to lead to the expectation that the bisulphite of lime will be advantageously employed in the Colonies in the manufacture of sugar. According to the first observations, the cane-juice, preserved from fermentation by means of the bisulphite of lime, can be made to undergo, without inconvenience, a decantation and filtration before being cleansed or defecated. The bisulphite of lime will also arrest the fermentation of the canes, which are oftentimes left, after having been cut, exposed to the heat of the sun, when any interruption takes place in the pressing process. M. Guiet appears to think that the ingenious process of M. Boucherie* for the preservation of wood may be applied to the injection of any of the sugar-cane with the bisulphite of lime, thus preserving it from fermentation. He has commenced a series of experiments on this subject.

SCOFFERN'S IMPROVEMENTS IN THE REFINING OF SUGAR.

No subject has been discussed at greater length in the foreign scientific journals, during the past year, than the improvements of Dr. Scoffern in the refining of sugar. The chief points in these improvements may be briefly stated. It is well known that acetate of lead has long been recommended for use in preparing sugar for the boiler, on account of its strong affinity for acids; but there was this objection to its application, that the refiner could never be certain that he had in the end wholly freed the refined sugar from the lead, together with the other impurities. The object of Dr. Scoffern was to attain this most desirable end. He used the sub-acetate of lead, which removed the coloring matter and the acids, leaving behind a small quantity of lead disseminated throughout the syrup. To effect the removal of this, he passed a current of sulphurous acid gas through the syrup, which threw down the lead in an insoluble state, as sulphite of lead. Upon the insolubility of this substance the perfection of the process depends. The remaining portion of the sulphurous acid is then expelled by heat. The sulphurous acid is obtained by passing a current of air over burning sulphur. The alleged objections to the process are, that it is impossible to wholly free the sugar and the remaining syrup from the presence of lead by the action of the sulphurous acid and the subsequent crystallizations, and it is upon this point that the applicability of the invention rests.

* Described in this volume under *Mechanics*.

NEW SPECIES OF SUGAR.

M. LAURENT, in the *Comptes Rendus*, Jan. 1, describes a new species of sugar, to which he gives the name Dulcose. It comes from Madagascar, but its origin is not well known. It crystallizes in oblique rhombic prisms, possesses a slight sweetish taste, and diffuses upon incandescent charcoal the same odor as sugar. From its composition it is homologous with grape-sugar, and like grape-sugar acts the part of a weak polybasic acid. According to M. Biot, it exerts no action upon polarized light; and according to M. Soubeiran, it does not undergo alcoholic fermentation.

NEW TEST FOR THE DETECTION OF THE PRESENCE OF SUGAR IN CERTAIN LIQUIDS, AND ESPECIALLY IN URINE.

SEVERAL processes have been described by chemists for the detection of sugar, even under the singular circumstances of diabetic disease. Unfortunately, none of the processes are of such simple execution as to be readily adopted by the medical profession. I now present chemists and physicians with a test by means of which the presence of the smallest quantity of sugar can be detected in an instant. By the action of chlorine upon sugar there is found a brown substance, which is partially soluble in water, a caramel, which is of a brilliant black color when dried. This effect produced by chlorine is obtained as easily, if not more so, with the chlorides, and especially with the perchlorides. All sugars behave like cane-sugar towards the chlorides; they experience a dehydration, the result of which is the brownish-black product. From these facts we learn the conditions under which we must place ourselves in order to obtain a reagent capable of detecting the presence of sugar. Let us suppose, in fact, a slip of solid substance, which is not altered by the chloride of tin even at a high temperature; cover this substance with a layer of chloride by immersing it in a concentrated solution and desiccating it; then dip the slip thus prepared in a very dilute solution of sugar, and expose it to a temperature of from 266° to 300° F. The part which has been immersed will immediately change color and become of a brownish-black, more or less deep. The substance best suited for receiving the coating of chloride of tin is white merino cloth. After having dipped the merino for three or four minutes in an aqueous solution of bichloride of tin, let the liquid drain off, dry the cloth in a piece of the same substance on the water-bath, and the reagent is prepared. It may then be cut into strips like ordinary test-papers. By means of this chlorinated merino, the physician will be able, without the least difficulty, to determine whether the urine of the patient contains an appreciable trace of sugar. It will be sufficient to pour one drop of the urine upon one of these strips, and to hold it over the flame of a lamp, or incandescent charcoal, to produce in an instant a very visible black stain. The sensitiveness of the test is wonderful; 10 drops of a diabetic urine, added to 100 cubic centimetres of water, furnish a liquid which turns the chlorinated merino completely brownish-black. Ordinary urine, urea, and uric acid are

not colored by the chloride of tin. — *M. Maument, in Comptes Rendus, March 18.*

PRESENCE OF FLUORINE IN BLOOD, MILK, AND SEA-WATER.

In 1846, Dr. Wilson, in announcing to the British Association the discovery of the existence of fluor-spar dissolved in many spring-waters, and also the fact of the solubility of this substance in water to a considerable extent, expressed an opinion that, in consequence of its dissemination to such an extent, fluorine would be found in blood and in milk. At the last meeting of the Association, Dr. Wilson stated that he had succeeded in verifying this opinion. From the residue obtained in the evaporation of three gallons of bullock's blood, sufficient fluorine was obtained to etch glass with great distinctness. Like evidence was also obtained from a similar treatment of the blood of a horse. It is therefore highly probable that fluorine is a constituent in the blood of nearly all animals. As regards its presence in milk, the ashes of 12 lbs. of new skim-milk cheese afforded a vapor which occasioned deep etchings in glass. The same was true of the residue obtained from evaporating 9 imperial pints of rich new milk; 4 pints treated in a like manner gave a faint trace of the presence of fluorine. In all these instances, it probably exists as fluoride of calcium. Dr. Wilson remarked that fluorine also existed in urine and in the bones of nearly all classes of animals. The extent of the solubility of fluor-spar in water, as determined by Dr. Wilson after repeated trials, is 0.26 gr. in 7,000 grains, or 16 fluid ounces. This amount, though comparatively small, is large for a salt reputed to be insoluble. — *Jameson's Journal, Oct.*

Fluorine in Sea-Water. — At the meeting of the British Association in 1849, Dr. George Wilson announced the discovery of the presence of fluorine in the waters of the German Ocean and in the Friths of Forth and Clyde.* Since that announcement, incrustations deposited in the boilers of steamers navigating the English Channel, the Atlantic, and the Mediterranean have been procured and examined. All yielded under proper treatment hydrofluoric acid, the two latter abundantly. Prof. Forchhammer of Copenhagen, from experiments made with the waters of the Baltic, estimates the quantity of fluoride of calcium in 100 pounds of the water of the ocean, which contain from 3.5 to 4 per cent. of salts, to be about 1 grain. Prof. Forchhammer has likewise proved the existence of phosphoric acid in sea-water. From these various experiments, says Dr. Wilson, we may infer, that, as the sea within narrow limits is very uniform in chemical composition, fluorine will be found universally present in the ocean. Indirect proof had before been obtained from its presence in corals and shells, as well as in marine fishes and Mammalia. — *Jameson's Journal, April.*

ALIMENTATION OF COFFEE.

A PAPER with the above title has been recently read before the

* See *Annual of Scientific Discovery*, 1850, p. 201.

French Academy by M. Gasparin, who presents it as the result of long and serious inquiry into the condition of the working population. The subject is one that cannot fail to be interesting wherever large masses of population have to be fed, as is the case in England and various parts of Continental Europe. Throughout France, the average amount of nitrogen contained in the daily food of grown-up men may be taken as from 20 to 26 grammes, about three fourths of an ounce. On the Belgian frontier, however, this quantity is much reduced, and a mode of economy is there practised upon the regimen, even when the supply of alimentary substances is very small. "The mining population of the environs of Charleroi," says M. Gasparin, "have resolved this problem, — to nourish themselves completely, preserve health and great vigor of muscular strength, upon a diet with less than half of the nutritive principles of that indicated by observation in Europe." The distinctive fact appears to be the habitual use of coffee at every meal. On rising in the morning, the workman makes what he calls his coffee: it is a weak infusion of coffee and chiccory mixed in about equal proportions. This drink, to which a tenth of milk is added, constitutes almost entirely the liquid part of the alimentation. Before going to work, the miner takes rather more than half a pint of this coffee, and eats a large slice of white bread with butter. He carries with him to the mine similar buttered slices and a tin bottle, which holds at most a quart of coffee; this food is consumed by him during the day. In the evening, on going home, he eats potatoes dressed with cabbage, or some other green vegetable, and finishes this repast with another slice of bread and butter and a cup of his coffee. All the workmen examined during the inquiry state that they eat a loaf in two days. These loaves weigh about 4 lbs., which gives 2 lbs. per day. They eat meat only on Sundays and festival days, and on those days drink 2 litres of beer. Their bread is always white, and of good quality; but it is only a few privileged workmen who eat meat on other days of the week; the exception is very rare. The quantity of butter consumed may be reckoned at 2 ounces per day, and that of coffee and chiccory at 1 ounce each also daily. The portion of potatoes and other vegetables cooked together and eaten in the evening is at most 1½ lbs. During the week the workmen drink neither beer nor any other fermented liquor; coffee is their only beverage.

After tabulating these quantities, M. de Gasparin continues: — "It is thus to 15 grammes (about half an ounce) of azote instead of 23 that the albuminous substance which enters into the ration of the Belgian miners is reduced. This nourishment is still inferior to that of the most austere religious orders imposed by mortification. I have studied and analyzed the diet of the monks of La Trappe. Their pale complexion, slow walk, the unimportant mechanical labor to which they are subjected, and which the laborers of the country estimate at not a fifth of theirs, all show that their alimentation is at a minimum in the circumstances in which they are placed. Yet it contains 15 grammes of azote, and 402 grammes of carbon, or of hydrogen, reduced to six equivalents of carbon. The nutriment of these miners is inferior also to that of the prisoners in our houses of detention, whose mechan-

ical labor is almost *nil*, resolving itself into easy movements of the arms, which require more of attention and skill than of strength. Their daily diet contains more than 16 grammes of azote and 475 of carbon. Now it must be added that the miner, whose diet is apparently as poor as we have described it, is a most energetic workman; that when French miners, who nourish themselves much more abundantly, attempt to work in the Charleroi mines, they are soon compelled to withdraw, not being able to keep pace with the Belgian workman in the execution of his task.

"It is to the coffee alone that we can attribute this possibility of contenting themselves with a diet which children would find insufficient; and it is not a question here of nutritious substance, for the analysis demonstrates that the coffee constitutes no more than one thirty-fifth of the nutritious properties of the aliment. It has thus other properties, of which careful account must be taken. Does it satisfy the digestive functions? Does it cause a more complete assimilation of the elements? Or rather does it not retard the mutation of those organs which do not then require so great a consumption of materials to repair or support them? According to this hypothesis, coffee would not nourish, but would prevent loss of substance." M. Gasparin then shows, from certain tables, that the waste in liquid excretion is less when coffee is drank than at other times, a fact which to some extent confirms his hypothesis. "We know," continues he, "how sober people are who drink much coffee. The prodigious abstinence of the caravans, the slightly nutritive regimen of the Arabs, come with all the authority of experience in support of the effects attributed to this beverage; and the distribution of coffee to the French troops during their fatiguing marches in Algeria is regarded by the officers as one of the best means of enabling the troops to support them." "Other substances must have analogous effects with those of coffee; we may mention the use of alliaceous bulbs in the South of Europe. On the other hand, M. Baral has recently shown that the use of salt very considerably augments the proportion of urea and of uric acid in the urine, thus producing entirely contrary effects to those of coffee. The easy circumstances of the population accustomed to the coffee regimen does not admit of a doubt. The only poor in the country are those whom accidental wounds, too frequent in the mines, deprive of the power of working. An old foreman, who knows the district well, and has been himself a laborer, informed me that a miner, with his wife and six children, lives on his daily earnings of two francs without making debts."

These researches may have very important consequences upon the fate of populations, and should be seriously considered by chemists, medical men, and economists. If it were proved, that, without injury to health, or to the development and continuance of strength, the use of coffee enables a man to be content with a much less abundant nourishment, it would be less difficult to provide for times of scarcity, and the importance of extending the use of this beverage would be too clearly understood for it to be oppressed with a heavy duty, which would be a real tax on an object of general consumption. — *Chemist, June.*

REMARKS ON THE ALIMENTATION OF COFFEE.

THE preceding paper having been submitted to the French Academy, M. Magendie presented a communication on the same subject. "It is true," says he, "that alimentary substances which contain little or no nitrogen are not nutritive, but to conclude, as is often done, that the proportion of nitrogen contained in an element gives exactly its nutritive power, is to greatly exceed the truth deduced from the experiments which have been made on this point of physiology. Many highly nitrogenous substances are not nutritious. Animals die of inanition on eating considerable quantities of gelatine, albumen, &c. They perish in the same space of time as if they had been fed on water alone. Fibrine itself, the almost sole base of muscular flesh, is not nutritive before having undergone its mysterious conversion into muscle. Dogs which eat at pleasure several kilogrammes of fibrine of the blood per day, and which digest perfectly, die, nevertheless, with all the symptoms of inanition, after a month of this very nitrogenous regimen. This same fibrine, cooked in excellent meat broth, which supplied the savory and saline principles of flesh, given as exclusive nourishment to dogs, was eaten with avidity by them, but did not nourish them; while dogs fed exclusively with gluten were well nourished, and for a long time. Raw flesh nourishes perfectly, and in very small quantity. Dried flesh nourishes much less. I have proved by experiments, that, to nourish a carnivorous animal, it is necessary to give in dry meat the same weight as of raw meat. Here the disproportion of the nitrogen in the two aliments is enormous, since raw meat in drying often loses nine tenths of its weight, retaining its nitrogen; therefore in these experiments nine or ten times as much nitrogen was required for obtaining the same nutritive result. Why this enormous difference between the nutritive properties of the same substance? Does the heat most frequently employed in the desiccation, as is the case with ferments, destroy certain properties of muscular flesh? In conclusion, I may add that every thing connected with the theory of nutrition is still concealed by an impenetrable veil. We know little or nothing concerning this important and fundamental phenomenon. We are beginning to comprehend the various acts of digestion, but all that happens after the formation and absorption of the chyle, all that passes in the blood and in the connection with the organic tissues and fluids, is still enveloped in the most complete obscurity." — *Statique Chimique des Animaux*.

INFLUENCE OF SALT ON VEGETATION.

DR. VÖLCKER presented a paper to the British Association containing the result of a series of experiments on the influence of solutions of salt on various plants, as cabbages, beans, onions, lentils, chickweed, groundsel, the thistle, radishes, and some grasses. None of these plants were affected during one month by solutions containing 24 grains of chloride of sodium to the pint of water, with the exception of *Anthoxanthum odoratum*, which was killed. Cabbages, rad-

ishes, and lentils were benefited by this solution, and not injured by solutions containing double the quantity. Solutions of 96 grains injured the others, but had no effect on onions, radishes, and *Carduus pratensis*. Onions were not injured by 192 grains of salt to the pint. Many of the plants had taken up so large quantities of salt as to taste like strong brine. — *London Athenæum*, Aug.

CONNECTION BETWEEN THE CONSUMPTION OF FOOD AND THE INCREASE IN WEIGHT OF ANIMALS.

THE *London Chemist* publishes the following table, showing the connection between the consumption of food and the increase in weight of animals per week for each 100lbs. live weight, as recorded by various observers. The animals selected for the experiments in the cases given were oxen.

Number of animals.	Duration of the experiment.	Food consumed per week to each 100 lbs. live weight of animal.		Increase per week upon each 100 lbs. live weight.
		Description of Food.	Quantities. lbs. oz.	
4	5	{ Linseed,	0 13½	} 1 8
		{ Bean-meal,	2 12½	
		{ Straw and turnips,	
4	4	{ Oil-cake,	1 13	} 1 1½
		{ Bean-meal,	1 13	
		{ Turnips,	
6	22	{ Peas,	1 13	} 0 14
		{ Linseed,	8	
		{ Turnips,	64 0	
6	22	{ Oil-cake,	3 5	} 0 13½
		{ Turnips,	66 0	

INFLUENCE OF A SALT DIET UPON THE ANIMAL ECONOMY.

POGGAILE has examined the blood of man, both at the time the usual diet was taken, and whilst 154 grs. of salt were consumed daily. The following are the results.

	During usual diet.	During salt diet.
Water,	779.9	767.6
Blood corpuscles,	130.1	143.0
Albumen,	77.4	74.0
Fibrine,	2.1	2.3
Fatty matters,	1.1	1.3
Extractive and salt,	9.3	11.8

From which it is evident that the proportion of solid constituents is increased; this occurs chiefly in the blood corpuscles and extractive, the amount of albumen being slightly diminished. — *Comptes Rendus*.

BOUSSINGAULT has recently made some observations concerning the influence of salt upon the fattening of cattle. His experiments show that salt does not exert that beneficial influence on the growth of cattle, and the production of flesh, which is usually attributed to it. The experiments extended over a period of thirteen months, and were made upon a number of steers, some of which had their rations salted, while others had not; in other respects they were treated in a precisely similar manner. The results show, that the increase in the proportion of flesh does not pay for the salt employed. It is, however, remarked, that a saline diet does exert a beneficial effect on the appearance and condition of animals; for the steers which were deprived of salt for eleven months appeared sluggish, and of a languid temperament, their coats being rough, devoid of gloss, and partially bare, while those which had been fed with salt were lively, had a fine glossy coat, and were sure to attain a considerably higher price in the market. — *Ann. Ch. Phys.*, XX., XXII.

DIFFERENCE BETWEEN DRY AND MOISTENED FODDER.

BOUSSINGAULT has recently tested by experiment the widely diffused view of the practical farmer, that soaked fodder forms a more suitable food than that which is dry. It was found that heifers fed with soaked hay gained in weight over those fed during the same time with dry hay, though the increase was so slight that it hardly compensated for the additional trouble. By reversing the order of feeding, the results were the same. The moistening of fodder also appears to have no influence upon the secretion of milk. The use of moistened fodder appears to be of advantage only in those cases in which quick fattening is required, since the cattle devour the fodder much quicker—nearly twelve times as fast—when it is in this condition. — *Liebig's Annual Report*.

NUTRITIVE PROPERTIES OF THE APPLE.

THAT apples are valuable as food for animals is now generally acknowledged, and their use for this purpose has, within a few years, been greatly extended, though it is probable that their relative value compared with other articles is but little understood. From accurate experiments, it has been ascertained that apples, after having been stewed with meal, in the proportion of four quarts of meal to a bushel of apples, when fed to swine, are fully equal, if not superior, in nutritive qualities, to the same amount of potatoes similarly prepared. A peck of apples a day, fed to a cow, has been found to add more than a quart to the daily quantity of milk, besides greatly increasing its richness, as well as improving the condition of the cow. The effect of apples is equally favorable on other stock. Horses fatten on them, and their coats assume a brilliancy which hardly any other food will give them. For all stock they answer a similar purpose as vegetables, in preventing costiveness, which is likely to ensue from exclusive use of dry food; and in this way, and by the nutriment they con-

tain, they contribute much to the animal's thrift. The apples should be ripe or nearly so, and of palatable kinds; sour apples, when fed in a raw state, are not relished much by animals, but by cooking with meal they are as equally well received as the sweet varieties. Recent chemical analyses by Mr. J. H. Salisbury, of Albany, show that good varieties of the apple are richer in those bodies which strictly go to nourish the system than potatoes are, or, in other words, to form muscle, brain, nerve, and in short assist in sustaining and building up the organic part of all the tissues of the animal body. — *Albany Cultivator*, Sept.

THE FIBRINE OF MUSCULAR FIBRE.

WHEN finely divided flesh is freed, by exhaustion with cold water and pressure, from matters soluble in this menstruum, a white tasteless residue is left, which consists of true muscular fibre, nerves, and cellular tissue. Muscular fibre is usually considered to be identical with the fibrine of blood; but this is an error, which has probably arisen from their similarity in physical properties. When the fibrine of the blood is immersed in water containing one tenth part of muriatic acid, in a short time it swells into a gelatinous mass; on the addition of a stronger acid, the jelly contracts nearly to its original volume, and again swells in water like a sponge. This experiment may be repeated several times without any perceptible quantity of the fibrine becoming dissolved in the liquid. The fibrine of muscular fibre is quite different in this respect. When placed in water containing the above amount of acid, the greater portion dissolves immediately and perfectly, forming a liquid which is slightly turbid from the presence of fatty matters, and which is with difficulty separated completely from the undissolved portions by filtration, although this may be perfectly effected. This solution takes place at ordinary temperatures. The solution coagulates when neutralized, forming a thick, white, gelatinous paste, readily soluble in excess of alkalies. The precipitate obtained on neutralizing the muriatic acid of the fibrine of muscle is soluble in lime-water, and the solution, when boiled, yields a coagulum like a dilute solution of albumen. If the precipitate has been previously boiled with water, it is insoluble in lime-water. But the most curious fact is, that this constituent of muscle, which is so readily dissolved in muriatic acid, exists in very different proportions in different kinds of animals. Thus, the muscular fibre of poultry and oxen is almost entirely soluble, whilst, in the case of the muscular substance of sheep, more than one half, and in that of the calf far more than this proportion, remains undissolved. This insoluble residue is elastic and white; but it is more gelatinous and softer than the fibrine of blood which has become swollen in slightly acidulated water. The fibrine of muscle especially differs from that of blood in the amount of nitrogen contained in it, and approximates to that of albumen. The fibrine constitutes only a fractional portion of 1 per cent. of the blood; in accordance with those analyses which are most to be depended on, it contains more nitrogen than the fibrine of muscle,

which renders the notion that it might serve for the formation of the latter very problematical. The iron, which is never absent, forms an important constituent of the fibrine of the blood. I have not been able in any manner to obtain fibrine of the blood free from iron. It has been concluded, from the color of the ash left on its incineration, which is sometimes perfectly white, that iron was absent; but even this white ash contains a considerable amount of iron. When blood fibrine, which has been well washed, is covered with water in a well-stopped vessel, and kept in a warm place, putrefaction soon ensues. It gradually becomes disintegrated, and in about three weeks is almost entirely dissolved, forming a slightly-colored liquid, in which some black flakes are suspended, the color of which arises from sulphuret of iron. This solution cannot be distinguished from a solution of albumen; it coagulates by heat, forming a gelatinous mass, which has all the properties, as also the composition, of albumen. This albumen is one of the most remarkable products of putrefaction. During the decomposition a highly fetid volatile product is formed, with a small quantity of free hydrogen. — *Liebig in the Annales de Chimie, Jan.*

EFFECT OF NITRIC ACID UPON BONES AND FLESH.

DURING the trial of Dr. Webster in Boston, Professor Horsford testified that he had tried experiments upon the effect of nitric acid in dissolving bones and flesh. He selected the hock-bone of beef, using the commercial nitric acid. In about four hours and twenty minutes the bone had disappeared, and in an hour more the vessel was entirely clear, with no trace of the bone. The flesh disappeared in three or four hours. No smell was perceived. Professor Horsford thought it would take rather more nitric acid than the weight of the whole flesh and bone to dissolve a human body. In the experiments a little more than four pounds of acid were used to four pounds of bone.

ON THE ACTION OF LIME ON ANIMAL AND VEGETABLE SUBSTANCES.

THE following statement concerning the action of lime on animal and vegetable substances has been contributed to *Jameson's Journal* for April, by Dr. John Davy. He says, — "It is commonly asserted and believed, that lime exercises a corroding, destructive influence on animal matter in general, and that animal bodies exposed to its action rapidly decompose and disappear. Accordingly, it has been almost invariably recommended to add this earth to graves, in instances in which a rapid decay is considered desirable, as on the occasion of the crowding of grave-pits with dead bodies, during the prevalency of pestilential diseases. From the results of many experiments which I have made with lime on animal and vegetable substances, I have been compelled to come to the conclusion, that this opinion is not well founded; indeed, that it is altogether erroneous."

The method observed in the experiments was, to immerse the animal matter for trial in a paste of lime contained in a wide-mouthed

bottle well corked and covered, so as to exclude the air and preserve the lime in a caustic state. In animal substances, the results in every instance were very similar. With the exception of the cuticle, the nails, and the hair, lime exerted on the different textures on which it was tried no destructive power, but a contrary influence, and more particularly a well-marked antiseptic one. Certain parts in a state of incipient putrefaction, and exhaling a fetid smell, lost their odor when in contact with lime and water, and ceased to be putrescent. Moreover, after having been fully subjected to the action of lime, they resisted putrefaction, whether placed in air or kept in common water. On the cuticle the action of lime is powerful, in consequence, as I apprehend, of a chemical combination being formed between them. It is well known how lime has the property of rendering the cuticle easily separable from the cutis vera, and how, in the art of tanning, it is applied to this purpose. The effect of lime on the nails is similar to that which it exercises on the cuticle, though not so strongly marked. On the hair it appears to be more destructive, but in what manner it acts I have not ascertained. What new arrangements of the elements of animal matter may take place under the influence of lime is a subject for further inquiry. Probably the effects of lime on the cuticle, nails, and hair, on which, in the arts, its operation has been best known, led to the idea generally entertained concerning its agency on animal substances." Dr. Davy also mentions, that it has been observed that, where the bodies of dead animals have been buried with and without lime, the dogs were attracted to those places where the bodies lay in contact with lime, without noticing others interred in the vicinity without lime. The explanation of this he conceives to be, that in the one case the dogs were attracted by the smell of the meat preserved by the lime, and not in the other, where it was not so preserved, and where it was undergoing putrefaction.

In regard to the action of lime on vegetable substances, numerous experiments conclusively show that it does not facilitate decomposition, and that, instead of promoting, it arrests fermentation. The circumstance, that no carbonic acid could be detected in lime after it had been in contact with vegetable matter, both with and without water, may be considered as demonstrative on this point. Lime in its solvent power is probably intermediate in degree between magnesia and the more active alkalies, more active even in combination, with one proportion of carbonic acid, than the magnesia, or even lime in a caustic state. The application of these results to agriculture, in relation to manures, is a subject of great importance and difficulty.

INFLUENCE OF ANIMAL CHARCOAL IN REMOVING THE ACTIVE PRINCIPLES OF PLANTS FROM THEIR SOLUTIONS IN WATER.

It is customary to clarify the impure solutions of vegetable active principles by filtering them through a deep stratum of animal charcoal. The researches of Lebourdais, however, show that this cannot be done without losing a large quantity of the valuable active principle; and he has even proposed to take advantage of the absorbent powers of

animal charcoal, as a means of extracting these principles. He takes the aqueous solution of the plant and boils it with bone-black, previously freed from phosphates by hydrochloric acid, until the liquor has become colorless, and is no longer of a bitter taste; the charcoal is then washed with water, and, after drying, extracted with boiling alcohol. The latter extracts the bitter principle, or the organic base, and it remains in a pure state after the evaporation of the alcohol. Coloring matters may be previously separated from the juice by means of a lead salt. Lebourdais states that he has in this way obtained the principles of *digitalin*, *columbin*, &c., in a crystallized state. — *Annales de Chimie et de Physique*, XXIV. p. 58.

ON THE PHENOMENA AND CAUSE OF FERMENTATION.

At the meeting of the American Association at New Haven, Mr. Erni presented a paper on the phenomena and cause of fermentation, of which the following is an abstract. It is well known among chemists, that, notwithstanding the voluminous writings on fermentation, we yet know very little of its original cause, and no one of the theories advanced is competent to the full explanation of the facts known at present. It is doubtless true, that in this process, by the action of the so-called ferment, organic bodies of complex composition, such as sugar, etc., are decomposed into simpler substances. The cause of these phenomena is considered by Liebig to be the power of the ferment as a body in a state of decomposition, i. e. in chemical action, to induce a similar transformation of compounds that come in contact with it. Other chemists assume that fermentation is caused by the development of fungi, and that different kinds of fermentation are due to different fungi. The results which Mr. Erni has obtained, a part of which have been fully corroborated by more recent examinations, have enabled him to throw considerable light on some disputed points. A great variety of experiments were published by Brendecke, according to which porous substances, as straw, feathers, alum, pulverized charcoal, potato-starch, flowers of sulphur, scraps of paper, and even small fragments of some metals, as tin, for instance, induce fermentation in a solution of grape-sugar to which some tartrate of ammonia had been added. After this it seemed probable that yeast, consisting undoubtedly of vegetable cells, might, like the substances mentioned, produce fermentation in solutions of cane or grape sugar, not by means of the vital force, but simply by its looseness and porosity. In repeating some of Brendecke's experiments, Mr. Erni had used grape-sugar prepared from honey by means of alcohol, and purified by boiling with charcoal, and cane-sugar prepared from white refined sugar re-crystallized from solution in hot water. In the experiments, one part of sugar and eight of water were employed. *First experiment.* — Common straw was treated with potash lye, to dissolve any gluten it might contain. After twenty-four hours the straw was washed with water, the last traces of potash removed by hydrochloric acid, and finally the straw perfectly cleaned with water. The solution of cane and grape sugar mixed with such straw underwent no change

during four weeks. *Second experiment.* — Addition of tartrate of ammonia to such solutions as the above produced no perceptible effect. *Third experiment.* — Straw cleaned as mentioned, together with cream of tartar, induced no fermentation in either cane or grape sugar. *Fourth experiment.* — Pulverized quartz added to solutions of cane and grape sugar caused no fermentation. In the course of some weeks mucor or mould was formed, which fructified and yielded spores. *Fifth experiment.* — A solution of cane-sugar was mixed with uncleaned natural straw in order to see if it excited fermentation, and if so, to ascertain if it might not be owing to the development of fungi. After twelve days, fermentation commenced, and at the same time microscopical examination of the liquor showed the presence of vegetable cells identical with upper yeast. *Sixth experiment.* — The same experiment performed with grape-sugar yielded the same results, but fermentation commenced some days earlier. *Experiments seventh to eleventh.* — These experiments were made upon yeast. Rousseau made known the supposed fact, that fermentation may be induced by yeast even in the presence of vegetable or mineral poisons, if rendered acid when mixed with the sugar solution. The trials of Mr. Erni did not confirm these statements. He found: —

1. That upper yeast in cane-sugar solution, acidified with tartaric acid, and poisoned with arsenious acid, produced no fermentation. The same mixture, without the addition of oxide of arsenic, fermented after two days. The liquor was strongly acid to the taste, became sweet again, and fermentation commenced.
2. The same trial was made in a liquor acidulated with acetic acid, and no fermentation took place. The same mixture, without the oxide of arsenic, produced fermentation.
3. The above two experiments were repeated, using oil of turpentine as a poison instead of arsenious acid, and the same negative results obtained.
4. Yeast, added to cane or grape sugar solution, acidified with tartaric or acetic acid, and poisoned with a few drops of creosote, excited no fermentation whatever.
5. Mixtures of cane and grape sugar with yeast, acidified with cream of tartar, and poisoned with considerable quantities of arsenious acid, produced fermentation.
6. The same experiment repeated, with the difference that, in the place of arsenious acid, creosote and oil of turpentine were employed, showed no fermentation. When the poisoned liquors were examined under the microscope, it could easily be seen when the poison had taken effect; the nitrogenous layer on the cell-membrane seemed to have undergone a change similar to that produced by boiling.

Mr. Erni's investigations have thus far led him to the conclusion, that *alcoholic fermentation is caused by the development of fungi*. He could never trace fermentation, without observing at the very first evolution of carbonic acid the formation of yeast-cells, although it is very difficult to decide certainly which precedes the other. He was rather in favor of the yeast-cells being the original movers, — the results of Mitscherlich's experiments. Helmholtz has also observed that the fermentation of grape-juice is not communicated to another portion of grape-juice which is contained in a vessel closed by a bladder and

introduced into the fermenting liquid. These facts, together with the experiments as to the action of poison on yeast, seem to admit of no other explanation, even by the ingenious theory of Liebig. Mr. Erni adduced a number of his experiments on other kinds of fermentation, showing that different kinds of fermentation are due to different kinds of fungi.

Prof. R. E. Rogers remarked, that while he regarded as interesting the fact stated by Mr. Erni, of the power of arsenic to "poison" the yeast fungus, and thus prevent its further development and propagation, and therefore to arrest vinous fermentation, yet he did not think we could from that conclude it to be a poison to all the lower forms of vegetation; or that, because a substance is a poison to animals (as in the case of arsenic), it is therefore so to vegetables. He cited the fact, that not only is vegetation freely developed in many saline solutions, but especially often in those of the arsenite of potassa and corrosive sublimate, — substances the most poisonous to animal forms, and in ordinary cases remarkable for their antiseptic properties.

ON A MEANS OF CHECKING DISEASE IN POTATOES.

DR. A. A. HAYES, of Boston, submitted to the Massachusetts Legislative Agricultural Society, in January, a communication in regard to the remedies which may be adopted for the prevention and arrest of the potato disease. He says, — "In the course of the experiments undertaken by me, it was noticed that a reduction of temperature by exposure to cold air greatly diminished the rapidity of decay, while a slight increase of temperature hastened it; moisture being present or not. Heat, in a moist atmosphere, increases the destruction, and samples which had been cooled, and thereby partly protected, readily passed through all the changes when again exposed to warm and humid air. After using several substances, by direct contact with diseased parts of potatoes, I soon found that the mixture of sulphurous acid, nitrogen, and common air, such as exists when sulphur is burnt in close vessels, would prevent the further progress of the disease in tubers already affected, and that when exposed in contact with tubers, passing through all stages of the disease, no further change in the prepared ones was induced. The trials were varied, and the uniformity of the results has led me to conclude that the fumes of burning sulphur, flowing in contact with potatoes partly diseased, will arrest the further progress of the disease, and prevent decay. It is proper that this conclusion should be received as an expression of fact, under the circumstances of experiments on a small scale, and with no more than two varieties of potatoes; but I confidently expect that the importance of the application will be seen in the largest exhibition of its effects.

"The practical use of the sulphurous acid gas is very simple, and not expensive. Crude sulphur, inflamed in a shallow, cast-iron vessel, or an earthen pot, furnishes the fumes, which may be led by wooden pipes to the lower parts of bins filled with the roots, until the unoccupied space is filled with them. As the fumes cool, they be-

come heavier than air, and will then enter every interstice. By placing the pot of burning sulphur in an empty barrel, and inverting over it a barrel filled with potatoes having a light rack in place of a head, the fumes will slowly rise within and impregnate the mass; the barrel and contents being then removed, and the head replaced, the exposure may be considered as ample. Where the quantity is large, it would be more economical to leave a space vacant below the loose floor on which they repose, and introduce there the fumes, until every part of the heap of potatoes has received a share. It should be remembered that this application will injure, if not destroy, the vegetating power of the tubers; and that, although this result may be highly desirable for all that are preserved for food, those intended for seed should not be so treated."

ON THE OCCURRENCE OF FORMIC ACID IN STINGING NETTLES.

PROFESSOR WILL, of Giessen, some time since showed that the fluid in the hairs of the procession-caterpillar, which causes an inflammation of the skin, as well as the liquid in the poisonous organs of some insects, is nothing else than formic acid. It became highly probable, therefore, that formic acid would also occur in the vegetable kingdom, and the first class of plants which was thought of was that which, by means of stinging hairs of similar organs, produces an analogous effect to the sting of certain insects. Acting on this suggestion, Dr. Gorup-Besanez has succeeded in detecting the presence of formic acid in various stinging nettles. It exists in minute quantities, and is supposed to be contained only in the stinging hairs, an assumption which is confirmed by microscopical observations, since, when a solution of silver is applied to the plant under the microscope, and a gentle heat applied, reduction always first occurs at the extremity of the stinging hair. — *London Chemical Gazette*, Jan. 1.

CONCENTRATED ANIMAL MANURE.

A PATENT with this title has been ordered to issue; but from delay in amendment of the claims it will not be published in the list of 1849. Its importance, however, embodying as it is believed facts and principles not hitherto generally known, demands some notice. To express a principal feature of the invention in few words, the inventor exposes the flesh of animals to the action of sulphuric acid of certain strength, by which it assumes a fixed state or condition, in which it may be kept for any length of time, without undergoing any further change. In this state the animal matter may be preserved for transportation, for manure, or for the manufacture of ammoniacal salts. The inventor in his description says, — "My invention has for its object the production of a concentrated manure, with nitrogen as an aliment, to be used as a substitute for guano. In the preparation, I make use of such organic substances as, whenever employed for manures at all, have been attended with the production of much nauseous effluvia, and the loss of a great part of their substance by the escape of the gases evolved, and

especially ammonia. Besides producing a valuable manure from the offals of slaughter-houses, fisheries, manufactories for extracting oil from fish or flesh, &c., the invention is intended to convert to a useful application such animal matters as do not ordinarily constitute the food of man; as, the flesh of horses, mules, dogs, rapacious beasts, birds, and fishes. The carcasses of porpoises, sharks, dog-fish, white-fish, and many others, are frequently thrown upon land as manure, either before or after the extraction of the oil. But this can be done only when the transportation is for a short distance. For want of suitable means of preventing putrefaction, and reducing the bulk and weight to diminish the expense of transportation, the use of the materials has been always confined to narrow limits, and the noxious and offensive gases which always accompany decomposing animal matter render such materials nuisances to the neighbourhood where they are found. Highly nitrogenized vegetable matter may also be treated in the same manner, and used for the same purposes.

"The process is as follows:—Putrefiable organic matters containing nitrogen are subjected to the action of concentrated sulphuric acid, or are mingled with various sulphates, nitrates, or chlorides, and especially the sulphates of iron, lime, soda, or potash, or with the nitrate of potash or of soda. The proportions used are such as to keep the weight of the acid, whether free or combined, when compared with that of the animal matter, from one fifth to one tenth of the latter. The acid or salt, acting as an antiseptic, secures the animal matter from decomposition. If the acid be free, or be held to its base by feeble affinity, as in the sulphate of iron, it secures the azotized portion of the organic matter from being food for worms, or flying off with hydrogen in the state of ammonia. Among the antiseptics employed is a mixture of sulphuric acid and nitrate of soda, and dry tan or sawdust, the first two ingredients being allowed to react before the addition of the ligneous matter. Besides preventing or arresting putrefaction, another property is secured in the use of the acids, salts, &c., the fixing of the fertilizing products of the organic materials treated, even when subjected to the temperature required to evaporate the water. This property allows the materials to be quickly dried without injury, and to be reduced in weight and bulk, and made susceptible of transportation with moderate expense. If the manure is to be long kept, or transported to considerable distances, after treatment by acids, &c., subject the organic matter to a process of desiccation, to vaporize the water, which renders it lighter and friable, and thus presents a material in a suitable state for sowing or spreading on land, like guano, or any pulverulent matter. In order to facilitate the union between the organic matter treated, and the acids and other agents employed, I use the acid in a concentrated state, in which the flesh, &c., is boiled. In this way the nitrogen is arrested, and the aqueous particles escape. From this treatment of the materials a gelatinous mass is obtained, which is mingled with pulverulent matter, either neutral or, it may be, an active fertilizer, according to circumstances, such as bone-dust, ground plaster, spent bone-black, coal ashes, road dust, spent tan, powdered charcoal, &c. During the for-

mation and mixing of pulverulent matter, while in the jelly or paste state, coal-tar, wood-tar, or petroleum, pitch, or rosin, is added to correct fetid effluvia, in case any should be evolved during the operation. When no actual putridity exists in the organic matter to be converted into manure, quicklime, or lime that has been used in purifying coal-gas, is sometimes used to effect the desiccation of such materials, and the mass is then formed into bricks or dumplings, for the purpose of convenience of transportation, and these may be pulverized or broken into fragments, for the purpose of distribution over the soil. But whenever putrefaction has commenced, the lime cannot be used, as by abstracting water it would cause the evolution of ammonia, and great loss of material would be sustained. — *Patent Office Report*, 1849.

HUMUS AND THE PART PERFORMED BY MANURES IN THE NOURISHMENT OF PLANTS.

IN the *Journal de Pharmacie* for July, M. Soubeiran publishes an important paper on the chemical analysis of humus, and on the part performed by manures in the nourishment of plants. The following is an abstract of the results obtained by him:—1. Ligneous tissue decomposed by contact with humid air changes into humus, and forms at the same time carbonic acid which can be absorbed by the roots of plants. 2. The proportion of carbon in the humus of mould and manure never exceeds 56 or 57 per cent. This is the extreme limit obtained by the decomposition of ligneous tissue in contact with air and humidity. 3. Pure humus contains $2\frac{1}{2}$ per cent. of nitrogen, which appears essential to its composition. 4. Humus is but little alterable by the action of the air. 5. Humus, which is but sparingly soluble in water alone, acquires solubility by combining with lime; but the principal agent of its solution is carbonate of ammonia, which reacts equally on free humus and on humus engaged in a calcareous combination. 6. *Humus, rendered soluble, is absorbed by the roots of plants. It assists directly in the nourishment of vegetables.* 7. Moreover, humus exerts a favorable action on vegetation, by attracting and retaining the humidity of the air and ammonia, by facilitating the solution of phosphate of lime, by ameliorating the physical qualities of the soil, and by moderating and regulating the decomposition of putrefiable animal matters. 8. Turf, modified by the contact of air, lime, and alkaline substances, has all the characters and properties of mould. It is extremely favorable to vegetation, after the addition of saline matters, alkaline and earthy chlorides, sulphates, and phosphates, in which it is habitually wanting. 9. The best manure is that which contains at once earthy and alkaline salts, ammoniacal salts, putrefiable animal matter, ready-formed humus, and vegetable refuse in the course of transformation. 10. In the appreciation of a manure, we should take into account, not only the proportion of nitrogen furnished by analysis, but also the state in which this nitrogen exists in the manure; that is to say, in the state of an ammoniacal salt or of putrefiable animal matter,—in the state of soluble ammoniacal salt or of

ammoniaco-magnesian phosphate. 11. The analyses hitherto made of fermented manures have been defective, in that they have not taken into account the loss which results from the action of carbonate of lime on the salts with ammoniacal bases, during the desiccation of the manures. It results, that the tables representing the proportion of nitrogen in manures, which have been published, can only give approximations. 12. The comparative values of manures cannot be decided by merely taking account of the quantity of nitrogen which they furnish by analysis, because, on the one hand, nitrogenous matters are not the only active elements in manure, and because the value of manures very much depends on the form under which the nitrogen exists in them; and, consequently, it is not possible to establish a table of equivalents for manures. 13. Finally, we must add to all these facts the remarkable observation of Mulder, who has proved that humus condenses the nitrogen of the atmosphere, and transforms it into ammonia.

ACTION OF SOILS ON THE CONSTITUENTS OF MANURES.

THE results of some important experiments respecting the action of soils on the constituents of manures have been laid before the Royal Agricultural Society, by Professor Way. Some of these experiments repeated before the society were as follows:—Several glass filter jars were prepared, filled with a red soil to the depth of five or six inches. Upon one of these Mr. Way poured water obtained from one of the sewers of London. To another filtering jar he added a quantity of the fetid liquid produced in the steeping of flax. Both of these liquids were turbid, highly colored, and exceedingly offensive to the smell; but when passed through the soil, they were no longer the same. The resulting liquid had an earthy smell, it is true,—a smell always accompanying soils,—but was no longer offensive to the nose. Now, to what ingredient of the soil is this metamorphosis due? Is it due to the sand acting as a filter? It was easily proved that such was not the cause; and that there might be no doubt on this subject, Mr. Way passed through a filtering-jar, containing more than nine inches' depth of fine white sand, a quantity of cow's urine taken from a tank in the country. The liquid was so far altered by the filtration that the turbidity was removed, as it would be by filtration through paper, but the color and disgusting smell remained in all their intensity. Sand, therefore, obviously was not the active ingredient in soils in respect to the power under discussion. The same must be said of the different forms of gravel, which were only coarse sand. The other great ingredient of soil was clay, and to this Mr. Way attributed the power in question. As an experiment comparative with the last, he passed the same tank-water through sand, mixed with one fourth of its weight of white clay in powder. The liquid coming through was clear and free from smell; indeed it was hardly to be distinguished by its external characteristics from ordinary water. There can be no doubt, then, that the property of soils to remove coloring matters, and organic matters yielding smell from solution, is due to

the clay contained in them. Filtration is only a method of exposing the liquid in the most perfect form to the action of the clay, but it is not necessary to the success of the process. In proof of which, Mr. Way stirred up a quantity of soil with putrid human urine, the smell of which was entirely destroyed by the admixture, and upon the subsidence of the earth, the liquid was left clear and colorless. It appears, therefore, that the clay of soils has the power of separating certain animal and vegetable ingredients from solution; but is this property the only one exhibited? Mr. Way had found that soils had the power to separate also the alkalies, ammonia, potash, soda, magnesia, &c. If a quantity of ammonia, highly pungent to the smell, is thrown upon a filter of clay or soil, made permeable by sand, the water first coming away is absolutely free from ammonia. Such is the case also with the caustic or carbonated alkalies, potash, or soda. A power is here found to reside in soils, by virtue of which not only is rain unable to wash out of them those soluble ingredients forming a necessary condition of vegetation, but even those compounds, when introduced artificially by manure, are laid hold of and fixed in the soil, to the absolute preclusion of any loss either by rain or evaporation.

Mr. Way has found that this property of clay applies not only to the alkalies and their carbonates, but to all the salts of these bases, with whatever acid they are combined. Here again is a beautiful provision; sulphate of ammonia, when filtered through a soil, leaves its ammonia behind, but the sulphuric acid is found in the filtered liquid; not, however, in the free state, but combined with lime; thus sulphate of lime is produced, and brought away in the water. In the same way muriate of ammonia leaves its ammonia with the soil, its acid coming through in combination with lime, as muriate of that base. The same is true of all the salts of the different alkalies, so far as he has yet tried them. Thus lime in the economy of nature is destined to one other great office besides those which have already been found for it,—it is the means by which the salts ministering to vegetation become localized and distributed through the soil, and are retained there until they are required for vegetation. Quicklime, when dissolved in water, is removed by passing the water through clay or through moist soils containing clay; and carbonate of lime in solution is so effectually removed, that hard water may be softened by the same process.

With regard to the extent to which these actions are capable of being carried, it is not to be supposed that we could go on filtering indefinitely with the separation of the salts contained in the liquid. On the contrary, the limit is soon reached; but although small in percentage quality, this power is, in reference to the bulk of the soil, enormously great. Prof. Way has found that 1,000 grains of pure clay will separate 2 grains of ammonia, and a cultivated clay soil, for obvious reasons, nearly twice as much. Now an inch in depth of soil over an acre of ground weighed about 100 tons, and would be adequate to combine with and retain 2 tons of ammonia, a quantity which would be furnished by about 12 tons of guano. Now, one sixtieth of this power would suffice for the preservation of the ammonia

of an outside dose of guano; consequently he was justified in saying that the property is practically of immense activity. Prof. Way stated, that he was first led into this train of investigation by having been informed that urine, by being passed through certain filtering substances, might be entirely deprived of its coloring matter and odor. He professed himself unable to account for the effect thus simply produced on chemical principles, but he considered them as fertile in a series of new facts, which will lead not only to new views of chemical combination, under peculiar mechanical conditions, but also to a modification of the theory of the mode by which manure is preserved in the soil until required as the food of plants, and to immediate application in practical agriculture. — *Albany Cultivator*.

DISCOVERIES IN RELATION TO PEAT.

DURING the year 1849, Lord Ashley and others startled the British House of Commons by an announcement that a method had been discovered by which Irish peat could be made to yield a variety of products of the most valuable kind, which would realize in the market a profit of upwards of 100 per cent. Much excitement was created by it at the time, and it was boasted that Ireland had at length found a means of wealth that would raise her forthwith to the height of prosperity. A few explanations, however, showed that, although the products mentioned could undoubtedly be obtained, there was no satisfactory evidence as to the real cost of the process and its consequent profit. Since that time little has been heard of the alleged discovery, until within a recent period, when a patent was granted for improvements in treating peat, and other carbonaceous and ligneous matters, so as to obtain products therefrom. The following is an abstract of the specifications, as given in the *London Patent Journal*. The first part of the improvement relates to the pressing of peat, by means of roller-presses suitably arranged for the purpose. The peat thus pressed and dried is next to be distilled in iron retorts, the patentee preferring those made of sheet-iron, and, if practicable, one placed within the other, so that the products obtained from the distillation may pass between the inner and outer retort, and escape through an exit-pipe in the outer. This exit-pipe dips into a strong iron box or condenser below the surface of the water contained therein; a pipe from this condenser communicates with others; these are fitted with taps to draw off the liquid products of distillation, and the gases pass off into the hydraulic main. If the gas does not possess sufficient illuminating powers, a portion of coal-tar, or some of the fatty matter of the previous distillation of peat is placed in the retort with the peat. Forty per cent. of charcoal may be obtained by removing the peat-charcoal from the retort after the distillation is completed; carbonic acid being applied to extinguish the combustion. This charcoal may be pressed into the form of bricks, for use in locomotives, marine engines, &c.; or, if required very pure, it undergoes the same process as animal charcoal. The next improvement relates to the use of *peat-gas* for the purposes of light and heat. As peat-gas does not possess

great illuminating powers, the patentee proposes to combine it with 30 to 40 per cent. of atmospheric air, and to burn it by means of peculiarly constructed burners, having a platinum wick, and with the tubes of the burners made larger than in the ordinary gas-lamp, and placed obliquely; the platinum attains a white heat, and great illuminating power is thus obtained. But as this process for increasing the illuminating power of peat-gas may be objected to, the patentee proposes to carburet the peat-gas. In addition to gas and ammonia, he also obtains from the distillation of peat a peculiar acid, and a bituminoadipose compound, which he calls "paranaphthadipose," as containing principally the elements of a hydro-carbon which produces a light naphtha, &c. One of the products of this is a good solvent of gutta-percha, caoutchouc, &c. A great variety of other products are obtained by chemical treatment.

Experiments made according to the above specifications have, it is said, been conducted on an extensive scale, with the most satisfactory results. The following statement has been published as the annual expenditure and produce of the trial works for one year:—

Expenditure.

36,500 tons of peat, at 2s. per ton,	£ 3,650
455 tons of sulphuric acid, at £ 7,	3,185
Wear and tear of apparatus, &c.,	700
Wages, labor, &c.,	2,000
Cost of sending to market, and other incidental charges,	2,182
Profit,	11,908
Total,	£ 23,625

Produce.

365 tons of sulphate of ammonia, at £ 12 per ton,	£ 4,380
255 tons of acetate of lime, at £ 14,	3,570
19,000 gallons of naphtha, at 5s.,	4,750
109,500 pounds of paraffine, at 1s.,	5,475
73,000 gallons of volatile oil, at 1s.,	3,650
36,000 gallons of fixed oil, at 1s.,	1,800
Total,	£ 23,625

POWER OF PEAT-CHARCOAL TO REMOVE COLORING MATTERS.

A WRITER in the *London Journal of Arts* for December states that the peat-charcoal which is left in the retorts after all the volatile constituents of peat have been distilled away, possesses the property of depriving colored vegetable solutions of the whole of their coloring matters. The writer finds that 25 per cent. more of this charcoal is needed than of bone-black, but the latter is about six times as expensive. Before using the peat-charcoal it must be purified from iron and sulphate of lime, and all alkaline matters.

INFLUENCE OF NITROGEN UPON VEGETATION.

It had been supposed hitherto that the nitrogen which enters into the composition of atmospheric air exercised but a very secondary influence in the process of vegetation ; that the amount of this substance which is absorbed by plants in considerable quantities was obtained exclusively from the soil and from manures. M. Wille, a French chemist, has been devoting himself during the last three years to the solution of the phenomena of vegetation, and has made this problem the subject of a communication to the French Academy. He declares that he has demonstrated, by a series of experiments, that the nitrogen of the atmosphere, far from being inactive, performs a most important part in the nutrition of vegetables. He submits the result, and prays the Academy to nominate a commission to examine his work, his process, his apparatus, and report upon the value which science should place upon his labors. The commission has been appointed. It consists of MM. Cherreul, Regnault, De Jussieu, Boussingault, and Payen.

RELATIONS OF THE NITROGEN OF THE AIR TO RESPIRATION AND VOICE.

PROF. JAMES MOULTRIE has published a paper on the uses of the nitrogen of the air in respiration. It is known that the quantity of nitrogen in expired air is not materially changed, or at least the change is not constant enough to warrant a belief that nitrogen takes any active and essential part in the chemistry of respiration. Physiologists have had to content themselves with the rather meagre view, that it serves simply to dilute the oxygen. Dr. Moultrie suggests that the nitrogen is important to the physical relations of the respiratory function, regulating the tension of the air in the pulmonary vesicles, or its volume, or both. It would serve chiefly to regulate the tension of the pulmonary air during expiration. As a medium of sound, responding in part to the vibrations of the vocal chords, or exciting their vibrations, or preserving the volume and tension of the pulmonic air in that state which is essential to the ready and constant use of these organs as instruments of voice, would not the withdrawing of one half of that element materially change their value in the part assigned them in animal life to fulfil? By ingenious symbols, Dr. Moultrie traces the nitrogen particles from the atmosphere till they part from their oxygen in the pulmonary vesicles, and shows that then, mingled with the carbonic acid and vapor which are to be exhaled, they must contribute to preserve the volume and tension of the cells and extreme tubes of the lungs. — *Charleston Medical Journal and Review*.

VALUE OF THE GREEN-SAND FOR AGRICULTURAL PURPOSES.

At a meeting of the Boston Society of Natural History in March, the following remarks were made relative to the economical value of the green-sand formation. Prof. Johnson, of England, stated, that in Great Britain, where it has been found, this substance possesses remark-

able fertilizing properties. He instanced the hop-lands in the southern counties of England, worth \$2,500 an acre, whose crops had been wonderfully increased by the application of the green-sand, acting by the phosphate of lime it contains: in some of these lands the marl, sometimes six feet deep, contains 14 to 20 per cent. of this salt. Green-sand probably contains the same fossils, the same phosphate of lime in various quantity, in all the tertiary formations of the globe, and everywhere will doubtless be of great value to the agriculturist. He had examined some poor specimens in the United States, which contained only 1 or $1\frac{1}{2}$ per cent. of the salt. To show that it may prove of considerable value even here, he mentioned that a single company in England got out from 60 to 100 tons a week, which, having been powdered, and prepared by solution in sulphuric acid, sold for \$50 a ton. Dr. C. T. Jackson remarked that phosphate of iron in fossil shells, and in conjunction with carbonate of lime, was common; and he thought the application of these substances, by double decomposition into phosphate of lime and carbonate of iron, would be advantageous in certain soils. He also mentioned the bog-iron ore, which contains much phosphoric acid; by adding lime to this, a valuable agricultural benefit might perhaps be obtained after the real amount of acid was known. Dr. Pickering observed that the green-sand of New Jersey contained phosphate of iron, and potash in considerable quantity; it there never becomes consolidated, and does not come to the surface, being covered by several feet of quartzose sand; it is in some places brought to light by streams which have cut through it, and has been dug out profitably. Prof. Rogers remarked, that for a long time the fertilizing property of the green-sand was supposed to depend on potash, or some other alkali contained in it; the presence of phosphate of lime has been omitted in all our analyses, even to the present time. He thought this might be easily accounted for from the fact, that this salt does not enter into the composition of the siliceous green-sand, but is an accidental ingredient introduced from the clay in which it is embedded; the washings of the clay have not been analyzed, but only the sand; hence only a series of silicates has been found; the true way is to analyze the marl and clay as well as the green granules. The green-sand is very efficacious in small quantities; 25 bushels to an acre of good land will double the crops; even blown sand, with 100 bushels of this to the acre, has been made to produce a very respectable crop of corn, its efficacy here being due principally to the contained potash.

AVAILABILITY OF THE GREEN-SAND AS A SOURCE OF POTASH AND ITS COMPOUNDS.

At the meeting of the American Association at New Haven, Mr. Wurtz, of New York, presented a communication on the availability of the green-sands of the cretaceous formation of New Jersey as a source of potash. The vast importance of potash and its compounds in the arts long ago impressed upon chemists the necessity of finding some source for this substance other than the ashes of forests. Experiments,

with a view of attaining this end, have been made repeatedly upon felspar; but, owing to the peculiar chemical and physical properties of this mineral, the success of these researches has been doubtful. It is proposed by Mr. Wurtz to make use of the green-sand as a source for obtaining potash, which, he thinks, is far superior to felspar in its adaptation to this purpose. The green-sand of New Jersey, according to Prof. H. D. Rogers, contains from 10 to 13 per cent. of potash; in two varieties analyzed by Mr. Wurtz he found 6.38 and 4.94 per cent.; these latter results were obtained, however, from green-sand intermixed with earth and sand, while the determinations of Prof. Rogers were made upon the material freed as much as possible from impurities. Besides potash, the green-sand contains nearly 50 per cent. of silica, with smaller quantities of iron, alumina, magnesia, and water. Considering that the green-sand contained the constituents of alum, with the exception of sulphuric acid, an attempt was made to extract alum from it by the addition of sulphuric acid. This was at first unsuccessful, owing probably to the presence of protoxide of iron and organic matter. A portion of the green-sand was then gently ignited, destroying the organic matter and peroxidizing the iron. The mass when treated with sulphuric acid yielded common alum, together with small quantities of iron alum, and sulphates of iron and alumina. Upon the addition of chloride of potassium, all the iron was converted into uncrystallizable perchloride, while the sulphate of potash formed by double decomposition combined with free sulphate of alumina to form common alum. In this way alum was formed in such quantities as to promise the most successful results in the practical employment of this process. The chloride of potassium employed in the process described, Mr. Wurtz has found, may be readily obtained by fusing the green-sand with chloride of calcium. The pulverized and ignited marl is mixed with sufficient quantity of chloride of calcium to form upon fusion a pasty mass. The decomposition of the green-sand takes place at a low temperature, and is so complete, that in most cases all the potash contained in it may be readily dissolved out in water, as chloride of potassium. Its separation from the excess of chloride of calcium is an easy problem, owing to the difference between their solubilities. This application of chloride of calcium will also open a market for the large quantities of this substance which are thrown away in some manufactories of soda-ash. — *Silliman's Journal*, Nov.

ON THE SECRET OF THE EMBALMING PROCESS.

THE charge of fraud being often alleged against the Egyptian undertakers, on account of the wholesale use of bitumen in the process of embalming, by which the body becomes so charred and calcined as readily to break into fragments, Dr. Cormack of London has recently published some statements, which seem to show that the application of heat to bodies filled with bitumen was the essential part of the mummifying process. In the opinion of Dr. C. mummies owe their preservation to creosote, formed by the application of great heat to the bitumen. No experimenter, says he, has ever yet succeeded in preserving

dead bodies by the methods given by Herodotus or Diodorus Siculus, and although we need not doubt that the ceremonial which they describe was adhered to by the embalmers, to invest their performances with the air of sacred mystery, we must undoubtedly look for something additional as the essential part of the preserving process. It appears that all the substances found within mummies are of a resinous nature, but that their mere introduction into the great cavities of the body, along with external lotions of wine, would answer the purpose of embalming, is contrary to fact. Nearly, if not all, the mummies have their muscular tissue impregnated with resinous matter. Most are also blackened and burned, and in some the tissues have been reduced to ashes. The inner bandages are generally in a state resembling tinder. It seems absurd to suppose that the application of heat was made from wanton mischief, or as a superfluous part of the process. Dr. Cormack therefore concludes, that, as this application of heat was never omitted, it must have been intentional, and that by means of it the body became impregnated with creosote, derived from the decomposition of the bitumen and bandages with which it was previously covered. The property of this substance, discovered by Reichenbach in 1830, to preserve flesh, he supposes to have been known to the Egyptian embalmers, and in fact to have been the secret of their art. The giving of sufficient heat to effect the decomposition of the tarry matter, and no more, must have been exceedingly difficult, and therefore it is that nearly all the bodies appear to have suffered by the excess of heat applied.

COCHINEAL.

WITHIN a comparatively few years, the culture and growth of the cochineal insect has been introduced, and so successfully carried out in various parts of the Old World, that the quantity yearly produced now rivals the whole amount obtained from Central America, the source from which all foreign supplies were first obtained. In 1831 the culture of the cochineal was commenced in the Canary Islands, and the first crop consisted of only 8 pounds; in 1832, it was 120 pounds; in 1833, it had risen to 1,319; and in 1849, we learn by a late official document, the enormous quantity of 800,000 pounds was exported from these Islands, the greater part of which was sent to England and France. In 1845, the quantity of cochineal produced in Java, under the patronage of the Dutch government, amounted to 45,000 pounds. Under the auspices of the French government, plantations have been commenced in Algeria, which promise to succeed admirably. Some specimens already exported have been pronounced to be superior to the finest qualities from Mexico. Soils unfit for the cultivation of the vine, or potato, readily support the cactus, on which the cochineal insect feeds, while the insect can be more readily raised than the silkworm, and with less chance of loss. — *Journal de Chimie*.

ADULTERATION OF VERMILION.

THE following analyses of samples of vermilion procured in the Bos-

ton market by Mr. Henry Brown, of the Cambridge Laboratory, probably indicates the average purity of this article as ordinarily sold. As pure sulphide of mercury upon the application of heat volatilizes readily, the fact of a residue remaining after igniting a sample of vermilion upon platinum is a proof of the presence of impurities. This test showed six out of ten varieties of vermilion submitted to analysis to be adulterated. The qualitative examination of the residues indicated the presence of carbonate of magnesia, sulphate of lime, chromate of lead, and red oxide of lead. Ammonia salts, or other salts of mercury, which are also volatile, are too expensive for the purpose of adulteration, — if they admit of being so incorporated with a superior quantity of genuine vermilion as to escape recognition. None of them were found upon examination.

The following abstract exhibits the result of the analyses : — Trieste vermilion, Sample No. 1, entirely volatilized upon platinum, Hg S (sulphide of mercury) = 100, pure. No. 2, do. No. 3, Hg S = 85.06, Mg O , C O^2 (carbonate of magnesia) = 14.94. No. 4, Hg S = 73.43, Mg O , C O^2 = 26.57. No. 5, pure. Sample No. 6, French vermilion, pure. No. 7, do., Hg S = 64.13, Ca O , S O^3 (sulphate of lime) = 35.87. Sample No. 8, Chinese vermilion, Hg S = 37.64, Pb O , Cr O^3 (chromate of lead) = 62.36. No. 9, do., Hg S = 37.88, Pb O , Cr O^3 = 48.12. Sample No. 10, American vermilion, so called. This consisted wholly of red lead, without a particle of mercury contained in it.

In color, Nos. 9 and 10 were a deep red, bordering on purple; No. 8 was lighter. Nos. 1 and 6 were lighter than Nos. 2, 3, and 5; and Nos. 2, 3, 4, 5, and 7 could not be distinguished from each other, so perfect was the incorporation of the white with the red. —
Editors.

NEW COLORING MATERIALS.

In the *Journal de Pharmacie et de Chimie* for January, M. Garot communicates some results respecting the red coloring substance of exotic and indigenous rhubarb, and its application to the arts. He finds that by treating one part of rhubarb with four parts of nitric acid, the residue which is not acted upon by the acid consists of a peculiar substance, amounting in the indigenous rhubarbs to from 8 to 10 per cent., and in the exotic rhubarbs to from 15 to 20 per cent. This substance, which in the indigenous varieties is yellow and in the exotic red, has been called *erythrose*, and forms with the alkalies red or purple compounds susceptible of application to the arts and to pharmacy. The erythrosate of potash possesses a tinctorial power (in alcohol or any other non-acid liquor) six times greater than cochineal, and the red obtained is brighter and as stable. The erythrosate of ammonia, after a dissipation of the excess of alkali, possesses the same properties as the potash compound, and its tinctorial power is at least four times greater. It may be employed as a red ink with advantage, and may be also used profitably in imparting a rose color to soaps. By modifying the mordants, the erythrose imparts to silk and wool

some very beautiful tints similar to those furnished by cochineal. For this purpose, the indigenous rhubarb, contrary to what would have been supposed, furnished the most brilliant red. The dyed specimens, after an exposure to the sunlight for a considerable length of time, did not experience the slightest change. These results may lead to the cultivation of the rhubarb as a dyeing material becoming of considerable importance.

A new material for dyeing yellow, called *wongshy*, has been recently exported from Batavia to Hamburg, and examined by M. Stein. It consists of the seed-vessels of a plant belonging to the family of the Gentianæ. The *wongshy* readily gives up to water, both at the usual temperature as well as on boiling, a coloring matter which possesses such an enormous divisibility, that 2 parts of the capsules when pounded furnish 128 parts of a liquid, which, when placed in a cylindrical vessel of white glass with a diameter of three inches, still appears of a bright wine-yellow color. Continued experiments made by M. Stein show that the *wongshy* will undoubtedly prove a valuable addition to the vegetable dyeing materials. — *Journal für Praktische Chemie*.

The *London Journal of Arts* for June contains a notice of some experiments upon *morindin*, a new coloring matter, closely resembling madder, and furnishing a deep red color. Its extraction and application are apparently attended with such difficulty that it will not be of much value economically, though very interesting in a chemical point of view.

ARSENATE OF COPPER AS A PIGMENT.

THE arseniate of copper is a substance possessing a very fine blue color, and seems worthy of occupying a high place in the list of substances employed in water-color painting; it is permanent, of a rich and beautiful tint, and may be used under all circumstances in which water can be made the vehicle of its application. A communication on the subject of this color has lately been presented by M. Rebouveau to the French Academy, from which we take the following. If a mixture of equal parts of arseniate of copper and neutral arseniate of potash be heated, it will undergo fusion, and form upon cooling a greenish-blue mass, transparent, very fusible, and having a vitreous fracture; this is the double arseniate of potash and copper. If, when the arseniates just mentioned are in a state of perfect fusion in a crucible, nitrate of potash (to the extent of one fifth of the weight of the fused mixture) be projected into the fluid, in successive small quantities, there will arise a lively effervescence, with evolution of the deutoxide of nitrogen; and the crucible when cold will be found to contain a magnificently colored blue substance, consisting of the subarseniate of potash and the arseniate of copper, in combination with each other, and mixed with nitrate of potash. When the compound thus produced is treated with water, the double salt is decomposed, the arseniate and nitrate of potash are dissolved out, — the arseniate of copper, of a beautiful blue color, remaining behind. In the production of the blue arseniate of copper, it appears that the change from the green color of ordinary arseniate takes place at the moment when the

nitrate of potash is added to the fused mixture in the crucible. Is not this, therefore, an indication that the oxide of copper itself has undergone a change? The chemical action here is somewhat obscure, but it is doubtless one of oxidation. It is evident that the potash is not the effective agent; for if, after adding the nitrate to the mixed arseniates, the heating be long continued after the effervescence has ceased, the compound again takes its original bluish-green color, — a change which can only be here traced to the liberation at an increased temperature of the oxygen which had, in the early stages of the process, produced the characteristic fine blue color. The question then is, Does an oxide of copper exist containing a larger proportion of oxygen than that forming the base of the ordinary green salts of that metal? Combined with arsenic acid, the superoxide seems to be stable at common temperatures, but easily reducible to a lower degree by exposure to a red heat, allowing the excess of oxygen to escape in a free state. The double arseniate of copper and potash, when placed in contact with water, is decomposed, and the arseniate of copper, on account of its insolubility, may then be readily separated. From its beautiful blue color, it can, no doubt, be rendered extensively useful as a pigment. — *London Mining Journal*.

ON A MINERAL BLUE COLOR EMPLOYED BY THE ANCIENTS,
WITH DIRECTIONS FOR ITS PREPARATION.

M. GIRARDIN has communicated to the French Academy a paper on the analysis and manufacture of a mineral blue paint, found in a Gallo-Roman villa, in the forest of Bretonne, in Normandy.

Several kilogrammes of this blue color were found in an earthen jar, in the state of friable concretions, which had evidently been a fine powder. It had no taste, was insoluble in water, but effervesced violently on contact with acids; 100 parts gave out 15.50 of carbonate of lime, with traces of oxide of iron, when treated with hydrochloric acid. After this treatment, the insoluble powder remaining had all the appearance of artificial ultramarine; it resisted the most powerful heat, and was neither fused nor altered in color. The most powerful acids had no action whatever on it; it was scarcely acted upon by nitro-muriatic acid; but when heated to redness with several times its weight of caustic potash, it fused, and on cooling presented a mass of a sombre green color, for the most part soluble in hydrochloric acid. No trace of cobalt was found. A quantitative analysis gave the following results: — Silica 49.4, alumina 6.4, lime, with traces of magnesia and iron, 19.4, soda 15.5, oxide of copper 9.3; total, 100.0.

This blue substance is, therefore, a glass, colored by oxide of copper, in all respects analogous to the *ceruleum* of Vitruvius, or the Alexandrian glaze which the Roman artists employed for fresco-painting, and the decoration of apartments.

Chaptal, in 1809, made a qualitative analysis of a color of the same kind, which was found in the shop of a color-dealer in Pompeii, and Descotils has subsequently recognized the same copper color in the hieroglyphical paintings in an ancient Egyptian monument.

Sir H. Davy speaks of the same mineral color. He states that the blue parts of the monument of Caius Cestus, and of the baths of Titus, at Rome, are done with this color. In an excavation made at Pompeii, in 1814, in the presence of Sir H. Davy, he found a pot of pale blue color, which he analyzed, and found to be a mixture of lime and Alexandrian glaze. Davy did not give any quantitative analysis of this blue color, but quoted the following passage from Vitruvius. "The preparation of this blue color was originally invented at Alexandria, and Nestorius has since established a manufactory of it at Puz-zola. Sand and flowers of natron (carbonate of soda) are first ground together as fine flour, then mixed with copper filings, moistened with a small quantity of water, and made into a kind of paste. It is then heated in an earthen pot, placed in a furnace, so that the mass becomes fused, and gives rise to a blue color." It was with this glaze that the Roman artists obtained all their shades of blue, by mixing the finely powdered glaze with various proportions of chalk. The beauty and solidity of this color, which resists the action of the most powerful agents, and is not affected by air, light, or moisture, ought to claim the attention of our painters and decorators, especially as it is also cheaper than smalt, azure, or cobalt. It may be obtained by strongly calcining for two hours, at a forge heat, a mixture of 60 parts of silicious sand, 45 parts of soda, and 9 to 10 parts of oxide of copper. — *Chemist, Sept.*

Hæmatinone. — Under the name of *hæmatinone*, a kind of glass was in use with the ancients, for the purpose of making ornamental vessels, mosaics, &c. It is described by Pliny, among others, and has been found pretty abundantly in the excavations at Pompeii. This glass is distinguished by its beautiful red color, which lies between those of minium and of cinnabar. It is opaque, harder than ordinary glass, susceptible of a fine polish, of conchoidal fracture, and its specific gravity is 3.5. By fusion it loses its red color, which cannot be restored. *Hæmatinone* contains no tin, or any other coloring matter, besides suboxide of copper. All attempts of the moderns to imitate it have hitherto entirely failed, but M. Pettenkoffer has at last succeeded in devising a method of producing this material in large quantities, so that, with requisite precautions, it may be cast into plates of any size, and worked into articles of every description. It is anticipated that this discovery will furnish a clew to many of the processes of the ancients in the manufacture of colored glasses, which have hitherto baffled all research.

CHEMICAL ANALYSIS OF A ROMAN PAVEMENT.

A PAPER was presented to the British Association, by Professor Buckman, on "some chemical facts connected with the tessellated pavements discovered at Cirencester." The materials of pavements are of two kinds, the first derived from the rocks of the district, and the second composed of clay, glass, &c. The former or natural *tessellæ* are altered by chemical manipulation in various ways. The artificial *tessellæ* consist of shades of red and black. In the Cirencester

pavement is a medallion of Flora, which on first being uncovered had a verdigris-green head-dress and flowers; but as this was unsatisfactory in chromatic arrangement, an examination was made, and, on scraping away the green surface, a beautiful ruby glass presented itself. An analysis showed that the change from ruby to green was due to the fact that the ruby glass had derived its color from peroxide of copper, and that the *tessellæ* had become covered with carbonate of copper from a decomposition of their surfaces. — *London Athenæum, Aug.*

INFLUENCE OF SUNLIGHT OVER THE ACTION OF THE DRY GASES ON ORGANIC COLORS.

A SERIES of experiments have been recently made by Dr. Wilson, of Edinburgh, on the effect of sunlight in modifying the chemical action of eight different dry gases—viz. chlorine, sulphurous acid, sulphuretted hydrogen, carbonic acid, a mixture of sulphurous and carbonic acid, oxygen, hydrogen, and nitrogen—on organic coloring matters. All of these gases were found to act more powerfully in changing colors when exposed to sunlight than when left in darkness. The effect was greatest in the case of the bleaching gases, especially chlorine, which may be left for three years in the dark in contact with coloring matter without bleaching occurring, provided moisture is excluded, whereas the same gas, though equally dry, was found to bleach dry coloring matter in six weeks if exposed to sunshine, so that a fortnight of sunshine is more than equal to a year of darkness in determining the decolorizing action of dry chlorine. — *Jameson's Journal, Oct.*

PURIFICATION AND PROPERTIES OF CHLOROFORM.

PROFESSOR GREGORY, of Edinburgh, in recent investigations, has found that the chloroform obtained from the best manufacturers is almost always contaminated with chlorinated oils, to the presence of which its disagreeable effects are to be ascribed. It is therefore a matter of some consequence to have delicate tests for the purity of this important substance. Pure and colorless sulphuric acid of 1.84 at least, on agitation, is colored yellow or brown, as the oil is more or less impure. Perfectly pure chloroform does not color the acid. Pure chloroform when poured upon the hand or a handkerchief rapidly evaporates, while the less volatile oils remain, and are recognized by their color, which is quite persistent. Dr. Simpson has mentioned that, while using a chloroform which had so constantly produced unpleasant effects that he threw it away, the handkerchiefs became quite offensive from the smell left upon them which remained after washing. Another test is the specific gravity, which for the perfectly pure article is 1.500. Mr. Kemp has also noticed another remarkable test of purity. As soon as the acid is no longer colored by the chloroform, the latter exhibits a strong convexity downwards toward the acid. The process for purification proposed by Mr. Kemp is to agitate with strong, pure sulphuric acid, allowing the liquid to remain in contact.

Half its volume of acid will be enough, and if but little color is given, a second use of the acid is not needed; but this should be tried on a small portion in a test-tube for greater certainty; the purification is finished with peroxide of manganese, with which it is to be agitated, and left in contact until the odor of sulphurous acid is removed. Redistillation is not required, — in fact, is not necessary to the manufacturer, who has only to wash well the first product with water, and purify as above. As an instance of what Prof. Gregory considers the gross ignorance of persons pretending to manufacture such articles, he refers to a sample examined by him of sp. gr. about 1.000, and which seemed to have the following origin. The maker obtained two fluids from distillation; not knowing that the heavy one was chloroform, he threw it away and put up the lighter, — a mixture of pyroxylic spirit, its original impurities, the chlorinated oils, and a mere trace of chloroform, — and labelled it *pure chloroform*. Almost pure from chloroform, Dr. G. well says. — *London Chemical Gazette*, May.

TEST FOR THE PRESENCE OF CHLOROFORM IN THE HUMAN BODY.

THE following is the description of a process and apparatus used for detecting the presence of chloroform in a human body, communicated to the *London Lancet*, by Dr. Snow.

The case was one in which the individual was supposed to have been murdered by means of chloroform. The blood, or portion of the body to be examined, was placed in a flask, from which proceeded a tube, made red-hot in part of its course. Another glass tube attached to the extremity of the latter was moistened inside with a solution of nitrate of silver, and terminated in a Wolfe's bottle, the interior of which was moistened with the same solution. Heat being applied to the flask by means of the chloride of calcium bath, the vapor given off had to pass through the red-hot tube, and any chloroform which might be present was decomposed; the chlorine and hydrochloric acid gas, being set free, were arrested in the next tube, where they formed a white precipitate of chloride of silver. The nature of the precipitate was also proved by cutting the tube with a file and introducing a drop or two of nitric acid into one portion, and a solution of ammonia into the other. In this way the presence of chloroform was detected in the bodies of two kittens, killed by inhaling the vapor, on six successive days after the death of the animals, although no precautions were taken to protect the bodies from the air, and the quantity inhaled by each kitten was less than one minim. The parts of the animals examined were the viscera of the chest and abdomen, the brains and muscles. From all, clear evidences of the presence of chloroform were obtained.

Dr. Snow had also obtained a precipitate of chloride of silver by operating on some portions of the muscles of a child's leg amputated under the influence of chloroform. The process was one of such delicacy, that he had been able clearly to detect the presence of the hundredth part of a grain when dissolved in a thousand grains of water. The only substances which can yield chloride of silver by

this method are Dutch liquid, chloride of ethyle, and some other bodies similar to chloroform in their composition and effects, and which are not in common use, or kept on sale. There are chlorides in the human body, but these cannot be decomposed below a red heat, and certainly not till the part becomes dry. In the process employed, the heat to which the parts under examination were exposed was only that of boiling water, or a very little more, so that in the most protracted examination they could not become dry, as the greater part of the moisture given off is condensed in the tube and flows backward into the flask. The method, therefore, says Dr. Snow, is liable to no fallacy or objection. Portions of the human body, taken from subjects dying from natural causes, have been found to give no traces of chloroform when treated according to the above process. In instances in which chloroform is present, the precipitate of chloride of silver begins to make its appearance when the heat applied reaches about the boiling point.

CHLOROFORM AS A DISINFECTANT.

At the meeting of the French Academy, on Nov. 11, a paper was read from M. Augend, in which he pointed out a new property of chloroform, its efficacy as a disinfectant. He describes an experiment in which he took three wide-mouthed flasks, the first containing a few drops of ether, the second, chloroform, and the third being left empty. In each of these a piece of beef was placed, and, the flasks being closed and left undisturbed, the following circumstances were observed:—The meat, which was of a reddish-brown color in its natural state, changed instantly to a vermilion-red in the mixture of chloroform and air, while in the ether vapor no change occurred. At the end of a week the difference was greater still; the meat in the flask containing atmospheric air was but little changed in its aspect; that in chloroform had acquired the appearance of boiled meat. On opening the flasks, it was found that the meat in the mixture of chloroform and air had the sweetish taste and odor of chloroform, while both the others were putrefied, and emitted a most offensive odor. M. Augend has ascertained that one 1200th of chloroform completely prevents the putrefaction of fresh meat. The most apparent action of the chloroform is the rapidity with which it traverses the thickest tissues, and causes an immediate contraction of their parenchyma, with consequent exudation of the fluids of the structure experimented upon.

NEW DISINFECTING COMPOUND.

M. HERPIN recommends dried and pulverized plaster of Paris, mixed with rather more than one fifth of its weight of powdered charcoal, as a cheap and most effective disinfecting mixture. It entirely removes the noxious emanations from decomposing organic matters, fixing the ammonia, and forming finally a valuable manure. — *Journal de Pharmacie*.

DETERMINATION OF THE QUALITY OF OPIUM.

THE process for determining the amount of morphia in opium is simple and easy of execution. A sample of about 15 parts (the author takes 15 grammes, equal to half an ounce) is to be selected from different portions of the mass of opium under trial. This is to be rubbed in a mortar with 60 parts (by weight) of alcohol at 70 degrees (density .890), thrown upon a cloth, and expressed to separate the tincture. The residue is again treated with 40 parts of alcohol of the same strength, and the united tinctures are to be received in a wide-mouthed bottle, containing 60 parts, by weight, of ammonia (density .923, we presume, according to the French codex). In twelve hours the result is obtained; the morphia is separated, but accompanied by a greater or less amount of narcotine, the morphia lining the sides of the bottle under the form of colored crystals, rather large and rough to the touch; the narcotine being found in small pearly crystals, white, and very light. The crystals are to be collected on a cloth, and washed several times with water, to separate the meconate of ammonia which adheres to them. They are then to be thrown into a small cup full of water. The narcotine, which is very light, remains suspended in the liquid, and can be readily separated, by decantation, from the morphia, which, remaining at the bottom, can be collected, dried, and weighed. An opium, to be of a good quality, ought to yield in this way from 1.25 to 1.50 of crystallized morphia for 15 of opium; some samples yield 1.75. This process, which succeeds perfectly well with opiums of good and middling quality, does not succeed with opiums which are poor in morphia or very resinous; but the fact of their not giving the results shows that they are of inferior quality, and ought to be rejected. — *Bulletin de Thérapeutique*, Feb. 15.

ACTION OF, AND TEST FOR, COD-LIVER OIL.

In a recent analysis of the blood of an individual taking the cod-liver oil, the animal matters were found nearly doubled, and the fibrine, usually high in pulmonary complaints, was reduced. There seems some reason, then, for supposing that, in addition to this healthy nutritive matter (a sort of magazine to the system), the oil supplies certain fat molecules, which appear essential to forming the nucleoli of the primary cells of ordinary tissues, fat having the physiological power of coagulating albumen around it. The cod-liver oil of a light brown color is supposed to be the best for pulmonary complaints, as it contains the most iodine, and in addition phosphorus, which is perhaps equally valuable. — *Medical Times*.

It has been discovered that, if pure nitric acid is poured upon the true cod-liver oil, in a short time it will change its color to a very delicate carmine-red; whereas, if it be impure, or mixed with other fish-oils, the color will be a dirty red or brown. Lard oil is much used in the adulteration, and the acid has no action, or a very imperfect one, upon it. When the acid is first poured upon the oil, it forms a

disk, and it is around the margin of this disk that the color is first discoverable. By gently agitating the mixture, the whole will change from a pink to the red color of carmine. White saucers are the best vessels for testing it in; and the quantity of the material to be used is an ounce of the oil to about a drachm of the acid.

NEW TEST FOR THE NITRATES.

THE following new test for the nitrates has been discovered by Mr. Schæffer:—Add to the solution supposed to contain nitrates one or two drops of yellow prussiate of potash. These should not be enough to give a perceptible tinge to the liquid. A few drops of acetic acid are then to be added, and immediately, or in a few minutes, according to the quantity of nitrate present, the liquid assumes a rich yellow tint.—*Proceedings of the American Association.*

ON THE PURIFICATION OF OIL OF VITRIOL FROM NITRIC ACID.

MR. ALEXANDER KEMP, of Edinburgh, has discovered a method of purifying oil of vitriol from nitric acid, which renders it unfit for many of its applications. He says, "If oil of vitriol be diluted to the specific gravity of 1.715, or thereabouts, and a stream of sulphurous acid be passed through it, the whole of the nitric, nitrous, or hypernitrous acid will be reduced to binoxide of nitrogen, which, along with the excess of sulphurous acid, may be totally removed by boiling." Instead of sulphurous acid gas, a saturated solution of sulphurous acid may be used.—*Jameson's Journal, April.*

TEST FOR QUININE.

M. VOGEL, JR., has discovered a new test for quinine. To a solution of quinine in alcohol or water, some drops of chlorine-water are first added, and then a concentrated solution of ferrocyanide of potassium, when the liquid assumes a beautiful bright-red color. If the solution of the ferrocyanide has not been sufficiently concentrated, the same effect is produced by adding some drops of ammonia. For the examination of quinine in a dry state, a small quantity of the body is placed in a watch-glass, and, while it is stirred with a glass rod, a few drops of chlorine-water are first added, and then the ferrocyanide. A beautiful red is produced, soon changing to green.—*Bulletin de Thérapeutique, Vol. XXXIX.*

CAIL-CEDRA, A SUBSTITUTE FOR QUININE.

AFTER the discovery of sulphate of quinine, endeavours were made to find an analogous medicine capable of supplying the place of this valuable substance; but all these were fruitless, and sulphate of quinine is still the febrifuge *par excellence*. But good quinquinas are becoming scarce, and very dear; the working of them, for many years, in their native forests, has been an actual devastation, and it is to be

feared that these valuable barks will ultimately fail altogether, or, at any rate, the price will become exorbitant. This most powerful febrifuge is found in countries where fevers possess great intensity; and its location is a dispensation of Providence, the intention of which cannot be mistaken. But South America and the Caribbee Islands are not the only countries in which fever makes numerous victims; in Africa and India this fearful disease reigns in full force. There must, therefore, exist in these countries trees well known to the natives which afford remedies to those attacked. It was with this persuasion that M. Caventou wrote to a French officer at Senegal, asking him if there did not exist in that colony a very powerful febrifuge in use among the negroes. He received in reply the bark of the cail-cedra, as the febrifuge most highly esteemed by the native population, who generally prefer the cheap decoction which they make of this bark to the sulphate of quinine offered them by Europeans. The bark cail-cedra is furnished by the *Swietenia Senegalensis*, one of the largest and most beautiful trees that ornament the banks of the Gambia and the lowlands of Cape Verde, and which belongs to the family Meliaceæ. The negroes take this bark in infusion or decoction for curing the fever; they also wash their shoulders, head, and arms with it. The color of the bark is grayish outside, and yellow under the epidermis. It develops, in mastication, a very perceptible bitterness, has a clear fracture and a close grain.

The organic principle which M. Caventou obtained from it is peculiar and quite distinct from those already known. He has designated it cail-cedrin. It is a solid body, opaque, resinous in appearance, yellowish, and of a non-crystalline form. The bark also contains a green fatty matter analogous to that contained in quinquina, which is aromatic and adheres strongly to the fingers. It also contains a red and yellow coloring matter, sulphate of lime, chloride of potassium, phosphate of lime, gum, fecula, waxy and ligneous matters. Experiments made with it at the Hotel Dieu seem favorable to its employment in intermittent fever. If we add to this fact those which are well known, afforded by the natives of Senegal, who cure the most violent attacks of fever with the aqueous decoction of the bark, we cannot but conceive well-founded hopes of the utility of cail-cedrin in therapeutics. — *Journal de Pharmacie*, Nov.

FREEZING OF THE ALBUMEN OF EGGS.

PROF. JAMES PAGET states that he has made some experiments on the freezing of the albumen of eggs, which, besides confirming Mr. Hunter's observation, that a fresh egg will resist freezing longer than one which has been previously frozen and thawed, also prove that, when fresh eggs are exposed to very low temperatures, together with eggs which are decayed or putrid, or the contents of which have been much altered by mechanical force or by electricity, a shorter time is sufficient for the freezing of the latter than is necessary for those which are uninjured. Though fresh eggs resist freezing longer than any others, they yet lose heat more quickly, their resistance to freezing

being due to the peculiar property of their albumen, the temperature of which may be reduced to 16° F., or much lower, without freezing, although its proper freezing-point is at or just below 32° . Other than fresh eggs lose heat comparatively slowly, but freeze as soon as their temperature is reduced to 32° . At the instant of beginning to freeze, the temperature of fresh eggs rises from 16° or lower to 32° . Experiment shows that this peculiarity is not due to the vital properties of fresh eggs, while it is probable that it is due to the mechanical properties of the albumen, for whatever makes it more liquid than it naturally is destroys the power of resisting freezing. Eggs kept at temperatures ranging from zero to 10° were afterwards developed in incubation. — *Proceedings of the Royal Society, Jan. 24.*

ON CERTAIN CONDITIONS OF FREEZING WATER.

IN a recent lecture before the Royal Institution, Mr. Faraday stated that water in freezing entirely expels all coloring matters, both salts and alkalies. Solutions of sulphate of indigo, diluted sulphuric acid, and diluted ammonia were partially frozen in glass test-tubes; as soon as the operation had been carried on sufficiently long to produce an icy lining of each tube, the unfrozen liquid was poured out and the ice dislodged. This ice in every case was found perfectly colorless, and, when dissolved, perfectly free from acid or alkali, although the unfrozen liquid exhibited in the first experiment a more intense blue color, in the second a stronger acid, and in the third a more powerful alkaline reaction, than the liquor which was put into the freezing mixture. Mr. Faraday also devised a method for making this ice perfectly clear and transparent as well as colorless, by continually stirring the liquid, while freezing, with a feather. In this way the globules of air were brushed away as they were dislodged from the freezing fluid, and thus prevented from becoming imbedded in the ice. Such ice as is imported into England under the name of the Wenham Lake ice, he regarded as one of the purest natural substances. Having noticed the rapidity with which water absorbs air as soon as it is thawed, he called attention to the importance of this natural arrangement to aquatic plants and animals, to whose life air is as indispensable as to those which live on land. Mr. Douny has discovered, that water when deprived of air does not boil until it reaches the temperature of 270° F., and that at that degree of heat it explodes. Mr. Faraday had also found that ice when placed in oil (so as to prevent its receiving any air from the atmosphere on thawing) would explode on reaching the boiling temperature. The extraordinary property of ice in solidifying water which is in contact with it, was also noticed. Two pieces of moist ice will consolidate into one. Hence the property of damp snow to become compacted into a snowball, an effect which cannot be produced on dry, hard frozen snow. Mr. F. suggested that a film of water must possess the property of freezing when placed between two sets of icy particles, though it will not be affected by a single set. Certain substances, as flannel, will also freeze to an icy surface, though other substances, as gold-leaf, cannot be made to do so. In this freez-

ing action latent heat becomes sensible heat, and the contiguous particles must therefore be raised in temperature while the freezing water is between them. It follows from this that, by virtue of the solidifying power at the points of contact, the same mass may be freezing and thawing at the same moment, and even that the freezing process on the inside may be a thawing one on the outside. — *London Athenæum*, June.

ON THE DIFFUSION OF LIQUIDS.

A SALT or other soluble substance, once liquefied and in a state of solution, is evidently spread or diffused uniformly through the mass of the solvent by a spontaneous process. It has often been asked whether this process is of the nature of the diffusion of gases; but no satisfactory answer to the question appears to have been obtained, owing to the subject having been studied chiefly in the operations of endosmosis, where the action of diffusion is complicated and obscured by the imbibing power of the membrane, which appears to be peculiar for each soluble substance, but not to be necessarily connected with the diffusion of the substance in water. In order to avoid this source of fallacy, Prof. Graham has studied the phenomena with an apparatus constructed as follows. It consisted of an open phial, to contain the solution of the salt to be diffused, which he calls the "solution cell"; which was entirely immersed in a large jar of pure water, so that the solution in the phial communicated freely with the latter, — the two together forming a "diffusion cell." The diffusion was stopped generally after seven or eight days, by closing the mouth of the phial with a plate of glass, and then raising it out of the water-jar. The quantity of salt which had found its way into the water-jar, the "diffusion product," as it was called, was then determined by evaporating to dryness. The characters of liquid diffusion were first examined in detail with reference to common salt. It was found, first, that, with solutions containing 1, 2, 3, and 4 per cent. of salt, the quantities which diffused out of the phials into the water of the jars, and were obtained by evaporating the latter, in a constant period of eight days, were as nearly in proportion to these numbers, as 1, 1.29, 3.01, and 4.00; and that, in repetition of the experiments, the results did not vary more than one fortieth part. The proportion of salt which diffused out in such experiments amounted to about one eighth of the whole. Secondly, that the proportion of salt diffused increased with the temperature; an elevation of 80° F. doubling the quantity of chloride of sodium diffused in the same time.

The diffusibility of a variety of substances was next compared, a solution of 20 parts of the substance in 100 of water being always used. Some of the results were as follows, the quantities diffused being expressed in grains: — Chloride of sodium, 58.68; sulphate of magnesia, 27.42; crystallized cane-sugar, 26.74; starch-sugar, 26.94; gum Arabic, 13.24; albumen, 3.08. The low diffusibility of albumen is very remarkable, and the value of this property in retaining the serous fluids within the blood-vessels at once suggests itself. It was further observed, that common salt, sugar, and urea, added to the albu-

men under diffusion, diffused away from the latter as readily as from their aqueous solutions, leaving the albumen behind in the phial. Urea itself is as highly diffusible as chloride of sodium. In comparing the diffusion of salts dissolved in ten times their weight of water, it was found that isomorphous compounds generally had an equal diffusibility, chloride of potassium corresponding with chloride of ammonium, nitrate of potash with nitrate of ammonia, and sulphate of magnesia with sulphate of zinc. The most remarkable circumstance is, that these pairs are equi-diffusive, not for chemically equivalent quantities, but for equal weights simply. The acids differed greatly in diffusibility, nitric acid being four times more diffusive than phosphoric acid; but these substances also fell into groups, nitric and hydrochloric acids appearing to be equally diffusive, as also acetic and sulphuric acids. Soluble subsalts and ammoniated salts of the metals present a surprisingly low diffusibility; the quantities of the three salts, sulphate of ammonia, sulphate of copper, and the blue ammonio-sulphate of copper, diffused in similar circumstances, being very nearly as 8, 4, and 1. When two salts are mixed in the solution-cell, they diffuse out into the water atmosphere separately and independently of each other, according to their individual diffusibilities. This is quite analogous to what happens when mixed gases are diffused into air. An important consequence is, that in liquid diffusion we have a new method of separation or analysis for many soluble bodies, quite analogous to the separation of unequally volatile substances in the process of distillation. Thus it was shown that chlorides diffuse out from sulphates and carbonates, and salts of potash from salts of soda; and that from sea-water the salts of soda diffuse out into pure water faster than the salts of magnesia. The latter circumstances were applied to explain the discordant results which have been obtained by different chemists in the analysis of the waters of the Dead Sea, taken near the surface; the different salts diffusing up with unequal velocity into the sheet of fresh water, with which the lake is periodically covered during the wet season. Prof. Graham has further shown, that chemical decompositions may be produced by liquid diffusion; the constituents of a double salt of so much stability as common alum being separated, and the sulphate of potash diffusing in the largest proportion. In fact, the diffusive force is one of great energy, and quite as capable of breaking up compounds as the unequal volatility of their constituents. Again, one salt, as the nitrate of potash, will diffuse into a solution of another salt, as nitrate of ammonia, as rapidly as into pure water; the salts appearing mutually diffusible, as gases are known to be.

Lastly, the diffusibility of the salts into water, like that of the gases into air, appears to be connected by simple numerical relations. These relations are best observed when dilute solutions of the salts are diffused from the solution-cell, such as 4, 2, or even 1 per cent. of salt. The quantities diffused in the same period of seven days from 4 per cent. solutions of the three salts, carbonate of potash, sulphate of potash, and sulphate of ammonia, were 10.25, 10.57, and 10.51 grains respectively; and a similar approach to equality was observed in the 2 and 6 per cent. solutions of the same salt. It also

held at different temperatures. The acetate of potash appeared to coincide in diffusibility with the same group, and so did the ferrocyanide of potassium. The nitrate of potash, chlorate of potash, nitrate of ammonia, chloride of potassium, and chloride of ammonium, formed another equi-diffusive group. The *times* in which an equal amount of diffusion took place in these two groups appeared to be as 1 for the second to 1,4142 for the first, or as 1 to the square root of 2. Now in gases the times of equal diffusion are *as the squares of the densities of the gases*. The relation between the sulphate of potash and nitrate of potash groups would therefore be referred to the diffusion-molecule of the first group having a density represented by 2, while that of the second group is represented by 1. The relation of the salts of potash to those of soda, in times of equal diffusibility, appeared to be as the square root of 2 to the square root of 3; which gives the relation in density of their diffusion-molecules as 2 to 3. Hydrate of potash and sulphate of magnesia were less fully examined, but the first presented sensibly double the diffusibility of sulphate of potash, and four times the diffusibility of sulphate of magnesia. If these times are all squared, the following remarkable ratios are obtained for the densities of the diffusion-molecules of these different salts, each of which is the type of a class of salts:—Hydrate of potash, 1; nitrate of potash, 2; sulphate of potash, 4; sulphate of magnesia, 16; with nitrate of soda, 3; and sulphate of soda 6. It is these diffusion-molecules of the salts which are concerned in solubility, and not the Daltonian atoms or equivalents of chemical combinations; and it is observed that a knowledge of the diffusibility of different substances is required for the study of endosmosis, in which the effect due to diffusibility should be distinguished and separated from the proper action of the membrane employed.—*Prof. Graham's Bakerian Lecture, Royal Society.*

ON THE CONDENSATION OF VOLUME IN HIGHLY HYDRATED MINERALS.

DR. PLAYFAIR called the attention of the British Association to the remarkable fact of the condensation of water in those bodies which contain that fluid in combination with solid matter. If a salt containing water of crystallization be dissolved in a measured quantity of water, it is found that its solid matter occupies really no space, the water in which it is dissolved increasing in bulk only by the quantity of water contained in it. In other words, it appears, that in many solid bodies, which contain water in a state of chemical combination, such a condensation occurs that they occupy no greater space than the water contained in them would if frozen into ice.—*Jameson's Journal, Oct.*

PHOSPHORUS IN COPPER, WITH A NOTICE OF EXPERIMENTS ON THE CORROSIVE ACTION OF SEA-WATER ON COPPER.

THE *Civil Engineer and Architect's Journal*, for November, 1849, contains a paper by Dr. Percy on "phosphorus in copper." Upon

analyzing a specimen of copper to which, when in a state of fusion, some phosphorus had been added, it was found that it contained a considerable quantity of phosphorus, and also a large portion of iron derived from an iron rod employed in stirring the mixture at each addition of the phosphorus. The copper employed was of the "best selected"; it appeared to be harder than copper treated with arsenic. The details of the analysis of 116.76 grains gave this result: phosphorus, 0.93; iron, 1.99. A second analysis gave; copper, 95.72; iron, 2.41; phosphorus, 2.41; total, 100.54. It has long been stated that a very small quantity of phosphorus renders copper extremely hard, but such an alloy as that formed by Dr. Percy had not been previously formed. It is a remarkable fact, that the presence of so large a quantity of phosphorus and iron should so little affect the tenacity and malleability of the copper.

In remarking on this paper, Capt. James said that the rapidity with which copper sheathing sometimes decays is surprising; sometimes it decays completely in five months, and, on the other hand, some of the old copper has lasted for forty years. To determine the cause of this difference he had made a series of experiments on all the copper used at the dock-yard at Woolwich. By steeping these different coppers in salt water for nine months, a series of actions set in, which, by subsequent weighing, were accurately determined. The following table exhibits the results of these experiments:—

	Loss per sq. in. — Grains.		Loss per sq. in. — Grains.
Electrotype copper, . . .	1.40	Dock-yard copper, No. 1,	1.66
Selected copper, . . .	1.10	“ “ “ 2,	3.00
Copper containing phosphorus,	0.00	“ “ “ 3,	2.48
Muntz's metal,	0.95	“ “ “ 4,	2.33

It may be well to add, that the specimens were wholly immersed in the water.

DIFFERENT CHEMICAL CONDITIONS OF THE WATER AT THE SURFACE OF THE OCEAN, AND AT THE BOTTOM, ON SOUNDINGS.

DR. A. A. HAYES, of Boston, has for some years been engaged in making chemical observations on sea-water, and has now collected evidence from different sources, sufficient to convince him that in general *the chemical agencies exerted at the surface of the ocean are the opposite of those observed in operation at the bottom, on soundings.* The method pursued has been that of carefully analyzing the results of corrosions of metals at the surface and at the bottom, as produced after exposures of months and years. It has been thus proved, that the oxygen dissolved from the air and other sources at the surface gives rise to corrosions which are generally oxides, sometimes oxides and chlorides. At the bottom, however, in depths less than 80 feet, — or perhaps at much greater depths, — a uniformity of effect has been observed, resulting in the production of sulphurets of the metals.

One interesting instance is thus stated. The Spanish ship San

Pedro de Alcantaro was destroyed by an explosion off the coast of Cumana, S. A., in the year 1815, and a large amount of coin sunk. Within the past year, through the enterprise of our countrymen, a portion of the silver dollars has been recovered. The coin was found on a muddy bottom, a strong crust of coral having in some instances formed over it. The pieces selected for the chemical trials exhibited the average amount of corrosion, — one the coinage of 1810, the other 1812. Dollars of these years in circulation weigh 412 grs. When the corroded dollars had been carefully washed in water and acetic acid, they were stripped of their coatings and weighed. That of 1810 weighed 330 grs., the loss being 82 grs., while the coin of 1812 similarly treated lost 55.18 grs. The water and acetic acid had dissolved a trace of chloride of copper and sulphate of lime; the incrusting coating, which had been detached by means of a feeble galvanic current, was a crystallized sulphuret of silver and copper; even the small portion of gold existing in that portion of the coin which was corroded had also united to sulphur. — *Editors.*

CORROSION OF A COPPER ALLOY OF SILVER, USED AS SHEATHING FOR SHIPS.

As a part of an extended investigation of the sea-water corrosion of metals, carried on by Dr. A. A. Hayes, of Boston, it became an interesting point to ascertain if an alloy of copper and silver would rapidly corrode, under the ordinary exposures. Four complete suits of sheathing copper, containing 4 lbs. of pure silver in 2,000 lbs. of alloy, were prepared by the Revere Copper Co. These were placed as usual on vessels destined for long voyages, passing through different seas, and the results have been recently obtained. Quite unexpectedly, it has been found that the dense copper thus formed does *not* resist sea-water corrosion so long as ordinary copper. But a fact more surprising is, the corrosion of the alloy without the exercise of any negative action on the part of the silver. It was assumed as a probable condition, that, if the corrosion should be more or less rapid, the silver would not be removed, but would be left with the partly corroded surface. On the contrary, careful analyses of the corroded sheathing and the assays of the masses resulting from the fusion of the whole remaining copper alloy concur in exhibiting exactly the original quantity of silver.

INCRUSTATIONS IN THE BOILERS OF STEAM-ENGINES.

A LETTER from Dr. J. Davy to Dr. G. Wilson, on "the incrustation which forms in the boilers of steam-engines," was read to the British Association, at Edinburgh. The writer states that he has examined specimens of such incrustations formed by deposition in voyages from port to port in the British and Irish Channels and the North Sea, between Southampton and Gibraltar, in the Mediterranean and the Black Sea, and in the Atlantic between Liverpool and North America and between Southampton and the West Indies. "The character and

composition of the incrustations I have found very similar; with few exceptions, crystalline in structure, and always composed chiefly of sulphate of lime, the other ingredients rarely amounting to 5 per cent. of the whole." Fluorine was detected in incrustations from Atlantic steamers, and also from those navigating the British seas. "In many instances, oxide of iron, the black magnetic oxide, was found to form a part of the incrusting deposit, collecting in one or more thin layers, and in some, especially of steamers navigating the narrower and least clear parts of the British Channel, the depositions presented a brownish discoloration produced by the admixture of a small quantity of muddy sediment. Incrustations so discolored are said to be most difficult to detach." The structure in most cases was not unlike the fibrous variety of gypsum. The specimens examined varied from a line and less to half an inch in thickness. In but few instances has information been obtained as to the time during which the incrustations were forming. In the boiler of the *Europa*, after a voyage across the Atlantic of eight and a half days, the thickness of the incrustation was one fiftieth of an inch, and was about the same on the outward voyage. The precaution of "blowing off" was used every three hours, and the "brine-pumps" kept constantly working. "In other seas, especially contiguous to shores, and more especially to shores formed by volcanic eruptions, it is probable, *ceteris paribus*, that the rate of deposit is more rapid, and some observations are in favor of this conclusion."

Various methods of preventing or mitigating this evil have been proposed, but the most effectual one is that of "blowing off," that is, "the discharging by an inferior stop-cock of a certain quantity of the concentrated water of the boiler by pressure of steam, after the admission above of an equivalent quantity of sea-water of ordinary density. But this can be viewed only as a palliation." The use of distilled or rain water is, however, an almost certain preventive. As it is impossible to obtain this always, at present, the great object must be to economize the escape of water in the form of steam, to use fresh water when available, and especially to avoid sea-water near coasts, where sulphate of lime is most abundant.

Examinations have also been made in two cases of incrustations from the boilers of locomotives, and in one case, from a running engine. The latter specimen "was fibrous, about half an inch thick, consisting chiefly of sulphate of lime with a little silica and peroxide of iron and a trace of fluorine. The former specimens were from one tenth of an inch to an inch thick. They were gray, laminated, and with much the appearance of volcanic tufa; they consisted principally of carbonate and sulphate of lime, with a little magnesia, protoxide of iron, silica, and carbonaceous matter, the last two ingredients being probably derived chiefly from the smoke of the engine and the dust in the air. From the engineer's report it would appear that the incrustation, which was one tenth of an inch thick, had formed in about a week, during which time the locomotive had run about 436 miles, and consumed 10,900 gallons of water."

In the course of a lecture on the "philosophy of a kettle," Dr. Far-

aday remarked upon the "fur" which is formed in kettles and boilers, often in great quantities. It consists of carbonate of lime, which is deposited from the water by the process of boiling, and in some specimens shown was two or three inches thick. The inconvenience arising from this accumulation may, however, be removed by the introduction of muriate of ammonia, when the muriatic acid combines with the lime, and forms a soluble product, which may be easily washed out. — *London Mining Journal*, June 1.

ON THE ACTION OF POROUS STRATA ON WATER AND ORGANIC MATTER.

It is a matter of immense importance to find from what source it is best to obtain water for large towns, and how it is to be collected. To these points Dr. Smith, in his report to the British Association on the air and water in towns, particularly directs attention. Regarding the conditions of many springs, which never become muddy, but possess a constant brilliancy and a very equal temperature at all seasons of the year, the author thinks that there is a purifying and cooling action going on beneath. The surface water from the same place, even if filtered, has not the same brilliancy or the same freedom from organic matter, nor is it equally charged with carbonic acid or oxygen gas. There are, therefore, other causes at work. The rain which falls has not the purity, although it comes directly from the clouds; it may even be wanting in cleanness, as is often the case. Springs rise through a great extent of soil, and collect a considerable amount of inorganic salts; and it is shown by Dr. Smith that their purity is due entirely to the power of the soil to separate all organic matter, and at the same time to compel the mixture of carbonic acid and oxygen. The amount of organic matter removed in this way is surprising, and it is a most important and valuable property of the soil. The change takes place even close to cesspools and sewers; at a very short distance from the most offensive organic matter, there may be found water having little or none in it. As an agent for purifying towns, this oxidation of organic matter is most extraordinary, and we find the soil of towns which have been inhabited for centuries still possessing this remarkable property. St. Paul's churchyard may be looked upon as one of the oldest parts of London, but the water from the wells around it is remarkably pure, and the drainage of the soil is such, that there are very few, if any, salts of nitric acid in it. "If the soil," says Dr. Smith, "has such power to decompose by oxidation, we want to know how it obtains so much of its oxygen. We must, however, look to the air as the only source, and see how it can come from it. When water becomes deprived of its oxygen, it very soon takes it up again, as may be proved by experiment. This shows us that, as fast as oxygen is consumed by the organic matter, it receives a fresh portion, conveyed to it by porous soil." Several experiments of the following character were adduced, to show the filtering power of the soil. A very dark solution of peaty matter was made in ammonia; this was filtered through sand, and came out per-

fectly clear and colorless. Organic matter dissolved in oil of vitriol was separated from it by a thickness of stratum of only four inches. A bottle of porter was by the same process deprived of nearly all its color. The material of which this filter is made is of little importance. One of the best, so far as clearing the water is concerned, is composed of steel filings, oxide of iron, oxide of manganese, and powdered bricks, all answering equally well. This shows that the separation of the organic matter is due to some peculiar attraction of the surfaces of the porous mass presented to the fluid. — *London Chemist, October.*

LOWER BLUE LICK SPRINGS OF KENTUCKY.

THE water of the Lower Blue Lick Springs has an extensive reputation in Kentucky, and in the South generally, this being one of the oldest and best-known watering-places in the valley of the Ohio and Mississippi. This remarkable spring attracted the attention of the earliest settlers of Kentucky, by its strong odor of sulphuretted hydrogen and the saltiness of its waters. It was, indeed, from this source that Boone and other pioneers obtained the salt with which to flavor their venison. Anterior to the advent of the whites, this place was the favorite resort of immense herds of buffaloes and other wild animals, who, led by instinct from different parts of the continent to drink the saline waters, left as memorials of their presence extensive roads or trails through woods and cane-brakes, which are visible even at the present day. The geological formation in which these springs occur is the same as that which underlies Cincinnati and the central fertile region of Kentucky, called by Western geologists the great blue-limestone formation, and constituting a lower member of the Silurian system. This formation in some places is of great thickness, composed of limestone layers of greater or less hardness and purity, with beds of bluish marly clay, all exceedingly rich in fossils. The well-known Big Bone Lick of Kentucky is seated on this same rock formation, and the composition of the water of the spring in that locality appears to be nearly analogous to that of the Blue Licks; it being a saline sulphur spring like the latter. Indeed, the blue limestone is very generally known as a saliferous formation, which is doubtless to be referred to its submarine origin. Numerous springs of salt water have been found on it, and many salt wells, some containing sulphuretted hydrogen, have been obtained in it by boring. Associated with the water thus obtained by boring in the blue limestone is sometimes found a large quantity of light carburetted hydrogen. The origin of this gas in the coal formations is doubtless from the vegetable matter that formed the coal, but in this formation it is a puzzle to geologists. Unless we suppose it to be derived, like the fluid bitumen sometimes discovered in this formation, from the decomposition of animal remains in the strata, no probable cause can be given for its production. The temperature of the Blue Lick Springs is about 62°, or a little greater than the mean annual temperature of the adjoining country.

During the past year the waters of these springs have been carefully analyzed by Dr. Peter of Transylvania University. Their composition, according to his analysis, is as follows:—

Specific gravity, 1.007 grains.

Gases in 1,000 grains:—

Sulphuretted hydrogen gas,	0.03947 grains.
Free carbonic acid gas,	0.35470 “

The former is in the proportion of about one thirty-sixth the volume of the water, and the latter of about one fifth the volume.

Saline contents in 1,000 grains:—

Carbonate of lime,	0.3850000 grains.
Carbonate of magnesia,	0.0022065 “
Alumina, phosphate of lime, and oxide of iron,	0.0058330 “
Chloride of sodium,	8.3472930 “
Chloride of potassium,	0.0226690 “
Chloride of magnesium,	0.5272000 “
Bromide of magnesium,	0.0009394 “
Iodide of magnesium,	0.0007340 “
Sulphate of lime,	0.5533300 “
Sulphate of potash,	0.1519190 “
Silicic acid,	0.0179400 “

The water also contains traces of oxide of manganese, and apocrenic and crenic acids. The quantity of saline and other matters brought out from the interior by this and other similar springs is immense, and sets at defiance all efforts to find out their source. As to the quantity of water which flows out at this spring, we find that it emits 678 gallons per hour, equal to 16,272 gallons in the day of twenty-four hours. Supposing the saline matters to constitute but one per cent. of the water, the amount brought out in one hour would be more than 58 lbs. avoirdupois. But say that 50 lbs. an hour is the proportion, and the quantity will amount to 438,000 lbs. per annum. The specific gravity of common salt being 2.257, this quantity in solid lump would contain about 310 cubic feet, or be enough to form a cube of salt nearly 7 feet on a side! And yet the water flows on without any sensible diminution of its saltiness. Whence is all this saline matter obtained? Is there, imbedded in the deeper strata of the blue limestone, an immense layer of rock salt, derived from the original ocean under which the rock was deposited?—*Report by Dr. Robert Peter, Ky.*

THE CAUSES AND PREVENTION OF MILDEW IN PAPER AND PARCHMENTS, WITH AN ACCOUNT OF EXPERIMENTS ON THE SATURATION OF GROWING WOOD WITH ANTISEPTIC SOLUTIONS.

THE following paper was read before the London Society of Arts by Mr. Alfred Glyde, in May:—Owing to the imperfections formerly existing in the microscope, little was known of the real nature of the plants called *fungi* until within the last few years; but since

the improvements in that instrument, the subject of the development, growth, and offices of the fungi has received much attention. They compose, with the algæ and lichens, the class of thallogens (Lindley), the algæ existing in water, the other two in air only. A fungus is a cellular flowerless plant, fructifying solely by spores, by which it is propagated, and the methods of attachment of which are singularly various and beautiful. The fungi differ from the lichens and algæ, in deriving their nourishment from the substances on which they grow, instead of from the media in which they live. They contain a larger quantity of nitrogen in their constitution than vegetables in general do, and the substance called "fungine" has a near resemblance to animal matter. Their spores are inconceivably numerous and minute, and are diffused very widely, developing themselves wherever they find organic matter in a fit state. The principal conditions required for their growth are moisture, heat, and the presence of oxygen and electricity. No decomposition or development of fungi takes place in dry organic matter; a fact illustrated by the high state of preservation in which timber has been found after the lapse of centuries, as well as by the condition of mummy-cases, bandages, &c., kept dry in the hot climate of Egypt. Decay will not take place in a temperature below that of the freezing point of water, nor without oxygen, by excluding which, as contained in the air, meat and vegetables may be kept fresh and sweet for many years.

The action which takes place when moist vegetable substances are exposed to oxygen is that of slow combustion ("eremacausis"), the oxygen uniting with the wood and liberating a volume of carbonic acid equal to itself, and another portion combining with the hydrogen of the wood to form water. Decomposition takes place on contact with a body already undergoing the same change, in the same manner that yeast causes fermentation. Animal matter enters into combination with oxygen in precisely the same way as vegetable matter; but as, in addition to carbon and hydrogen, it contains nitrogen, the products of the eremacausis are more numerous, being carbon and nitrate of ammonia, carburetted and sulphuretted hydrogen, and water; and these ammoniacal salts greatly favor the growth of fungi. Now paper consists essentially of woody fibre, having animal matter as size on its surface. The first microscopic symptom of decay in paper is irregularity of surface, with a slight change of color, indicating the commencement of the process just noticed, during which, in addition to carbonic acid, certain organic acids are formed, as crenic and ulmic acids, which, if the paper has been stained by a coloring matter, will form spots of red on the surface. Spots of the same kind are similarly formed on leather colored during its manufacture. Provided the fungi have not taken root, the color can be restored by ammonia or any alkali. The same process of decay goes on in parchment as in paper, only with more rapidity, from the presence of nitrogen in its composition. When this decay has begun to take place, fungi are produced, the most common species being *Penicilium glaucum*. They insinuate themselves between the fibre, causing a freer admission of air, and consequently hasten the decay. The substances most successfully used as preventives of decay

are the salts of mercury, copper, and zinc. Bichloride of mercury (corrosive sublimate) is the material employed in the kyanization of timber, the probable mode of action being its combination with the albumen of the wood, to form an insoluble compound not susceptible of spontaneous decomposition, and therefore incapable of exciting fermentation. The antiseptic power of corrosive sublimate may be easily tested by mixing a little of it with flour-paste, the decay of which, and the appearance of fungi, are quite prevented by it. Next to corrosive sublimate in antiseptic value stand the salts of copper and zinc. Chloride of zinc has been patented by Sir W. Burnett for the preservation of wood, sail-cloth, &c., and appears to succeed admirably. For use in the preservation of paper, the sulphate of zinc is better than the chloride, which is to a certain extent deliquescent.

A series of experiments were made, in the summer of 1840, on the use of metallic and other solutions for the preservation of wood. A deep saw-cut was made all round the circumference of some growing trees near their bases, into which the solutions were introduced by forming a basin of clay beneath the cut; thus the solution took the place of the ascending sap, and in periods of time varying from one to three days was found to have impregnated even the topmost leaves of trees fifty feet high. The trees were chiefly beech and larch. After impregnation they were felled, and specimens about five feet long by two inches square were cut out, and packed in decaying saw-dust in a warm, damp cellar, where they were left for seven years. The details of the experiment are given in a table, by which the following general results are made to appear: — The pieces of wood saturated with sulphate of copper in the proportion of one pound to one gallon of water, or with acetate of copper in the proportion of one pound to one pint of vinegar and one gallon of water, were found in perfect preservation, clean, dry, and free from fungi; but the remaining pieces, which were saturated with nitrate of soda, prussiate of potash, acetate of lead, sulphate of iron, common salt, and creosote, presented much decay and a large growth of fungi. The results obtained with solutions of corrosive sublimate, one eighteenth of a pound to a gallon of water, varied in an anomalous manner. — *London Chemical Gazette*, July.

SIMPLE PROCESS FOR DEMONSTRATING WITHOUT DANGER THE LIQUEFACTION OF GASES.

BERTHELOT, in the *Comptes Rendus* for May 27, describes a new process adopted by him for demonstrating the liquefaction of gases, and particularly of carbonic acid, which is founded on the employment of the dilatation of a liquid as the means of pressure. He says, — “I take some glass tubes of considerable thickness relatively to their bore, close them at one end, fill with pure dry mercury deprived of air, and then draw them out so as to render them quite capillary at their open end, without diminishing the relation between the thickness and the internal diameter. I then heat the tube in a water-bath, its open point being immersed in a current of the gas which I want to compress. By the dilatation of the mercury a portion is expelled from the tube.

When the temperature of the bath has reached 122° F., for instance, I gradually cool the tube to 32° , when the mercury contracts and the gas takes the place of the expelled mercury. I then withdraw the point from the current of gas, and immediately close it by sealing it at some millimetres from its aperture. The tube thus charged is replaced in the bath, which is again raised to 122° , then gradually higher, and the state of the gas observed in the capillary portion situated out of the bath at the ordinary temperature. In this manner I have condensed chlorine and ammoniacal gas, the bath for the latter being at the temperature at which the mercury filled the tube, the chlorine slightly below it in a tube full of sulphuric acid. Carbonic acid in a tube full of mercury at 122° F., becomes liquid at 131° , the temperature of the bath, if the tube is very thick, otherwise at 138° , and at a lower temperature by pouring a few drops of ether over the end.

"These experiments are free from danger; the only precaution necessary is to have the tubes well drawn out; they then always burst in the widened part filled with mercury, which is accompanied with no explosion or projection. This method furnishes us an easy means of showing on a small scale the liquefaction of gases. Barometer-tubes somewhat strong, and the use of sulphuric acid in default of mercury, answer perfectly well. I have tried to apply this method to those gases which have hitherto not been liquefied. For this purpose I filled three tubes, one with deutoxide of nitrogen, a second with carbonic oxide, and the last with oxygen; the tubes were filled with mercury at 122° , and the bath raised to 140° ; the first tube then burst, while the two others did so at 158° . There was no trace of liquefaction perceptible. Perhaps by carrying the pressure nearly to the bursting of the glass, especially with the assistance of a powerful refrigeration, new results may be obtained by this method. If want of success by this plan, which enables us to obtain almost indefinite pressure, should continue, we should probably conclude, as Mr. Faraday has already hinted, that pressure alone is not capable of effecting the liquefaction of gases under certain conditions of temperature."

ON THE QUANTITY OF ASH CONTAINED IN VARIOUS KINDS OF WOOD.

CHEVANDIER has communicated the following as the mean results of a great number of determinations of the average amount of ash contained in various kinds of wood, dried at 140° .

Ash given by 100 Parts of Wood.		Average Amount of Ash given by all Kinds of Wood.	
Willow	2.00	100 parts wood from young stems	1.23
Aspen	1.73	" " Stock-wood	1.34
Oak	1.65	" " Branches	1.54
Alder	1.38	" " Twigs	2.27
Red Beach . . .	1.06		
Pine	1.04		
Fir	1.02		
Birch	0.85		

AMMONIA IN THE AIR.

At the meeting of the American Association at New Haven, Professor Horsford presented a paper in continuation of the communication made by him to the Association in 1849,* in relation to the ammonia in the atmosphere. The relative quantities of ammonia found in the rain and snow water had been determined in a number of instances. The following table exhibits the results of several determinations and their date:—

Ammonia in Rain and Melted Snow in one Cubic Metre.

1849, Dec.	22,	in rain,	1.56 gr.
"	" 29,	in snow,	2.63 "
1850, April	4,	in rain,	0.24 "
"	" "	in snow,	0.72 "
"	March 18,	in "	1.49 "
"	" 22, 23,	in "	0.96 "
"	July 16,	in rain,	1.29 "

Professor Horsford announced his intention of continuing his observations throughout the coming year, that all the sources of error might be eliminated, and the subject fully investigated.

Origin of Ammonia in the Atmosphere.—At the American Association, New Haven, a paper was presented from Dr. A. A. Hayes, on the assumed existence of ammonia in the general atmosphere. The object of this paper was to show that ammonia is not found to be a general constituent of the atmosphere, but that the ammonia found by chemical analysis of the air near the surface of the earth is derived from an organic substance discovered by Zimmerman, and called by him pyrrhine. To this substance, which exists universally in rain and snow water, Dr. Hayes attributes the fertilizing effects of snow, rain, and the water contained in arable soils. He adduced instances of very rapid vegetation as produced by the formation of pyrrhine in fermenting mould. He regards ammonia as a poison to plants, though he attaches great value to it as a neutralizing agent to acids of soils and as serving to convey other ingredients, such as carbonic acid and the organic acids of soils, into the circulation of plants.

CARBONIC ACID IN THE AIR.

M. LEVY, a chemist who has been engaged for several years in investigations upon atmospheric air, reports to the Academy of Sciences the result of his labors. His communication is addressed to the Academy from South America, and signalizes facts which are highly paradoxical, especially in relation to the quantity of carbonic acid which the air contains. He finds in the months of August and September forty-seven parts of this acid in one thousand parts of air, while in the months of March, April, May, June, and July, the quantity of this acid never exceeds three or four parts in ten thousand. He affirms that he has been very exact in his experiments, and made

* See *Annual of Scientific Discovery*, 1850, p. 219.

use of the most approved instruments. On his passage from Europe to South America, M. Levy made experiments to ascertain the proportions of oxygen and of carbonic acid contained in the air upon the surface of the ocean by night and by day. He invariably found that these ingredients were in greater proportion during the day than during the night, and in fine weather than during cloudy weather. — *Paris Correspondent of the National Intelligencer.*

GUN-COTTON, AND NEW EXPLOSIVE COMPOUND.

GUN-COTTON dissolved in ether has, it is well known, been successfully employed as an application for incised wounds. When washed over the surface, the ether, rapidly evaporating, leaves behind a film which is impervious to air; and thus the wound, protected from atmospheric influences, heals by the first intention. This curious compound has been also employed successfully as a remedy for toothache. The cavity of the tooth being cleaned out, a little asbestos saturated with collodion, as it is called, in which a little morphia is added, is placed in it. All soon becomes solid; and thus an excellent stopping and a powerful anodyne are applied at the same time.

Gun-cotton was used, for the first time in actual warfare, at the siege of Moultan, India. The brilliance and breadth of the flash of the guns fired by this new adaptation of science to the devastation of war are described as of terrific intensity.

A series of experiments relative to the temperature at which gun-cotton explodes have been instituted by Dr. C. Marx. It results from these, that it explodes even at 144° F., but on an average at 199°, when raised to this temperature from that of the air within five minutes. Further, that it does not explode when heated so slowly that the temperature is not increased more than 5° F. per minute, but begins to be slowly decomposed at 131°, and its explosive force is very much weakened with the progress of the decomposition. This circumstance deserves attention in respect to the conveyance of explosive cotton, as metallic objects readily acquire a temperature of 144° by exposure to the sun. — *Poggendorff's Annalen*, LXXVIII.

New Explosive Compound. — The following is the recipe for a new explosive compound, discovered during the past year, said to have ten times the force of gunpowder. One part yellow prussiate of potash, well dried; one part sugar, well dried; two parts chlorate of potash. These materials are finely ground separately, and then intimately mixed. This compound differs from ordinary gunpowder in being explosive even in the form of fine powder, no granulation being necessary. Other advantages claimed for it are its easy formation, — the ingredients previously powdered may be mixed only when wanted; the absence of action of air on the separate materials, while charcoal for gunpowder is injured by exposure; and, lastly, the greater force. On the other hand are its corrosive effects on iron barrels, for which bronze must be substituted, and its dangerous inflammability. It is extremely dangerous to introduce gunpowder, sulphur, or charcoal into the mixture, the smallest quantity causing a violent explosion when ignited.

NEW METHOD OF DECOMPOSING SILICATES.

A NEW method of decomposing silicates in the process of analysis has been announced by Mr. Henry Wurtz, of New York. It consists in the employment as a flux, in the decomposition of the silicates by fusion, of the chlorides of several of the alkaline earths, as the chlorides of barium, strontium, and calcium, the two former being preferable. Felspars and hornblendes, on fusing with these substances, are readily decomposed on treating with hydrochloric acid. The method appears to possess many advantages, for decomposing silicates which contain both the alkalies, over the ordinary methods of fusion with hydrate or with carbonate of baryta. — *Silliman's Journal*.

ON A PECULIAR COMPOUND OF LARD AND ROSIN.

AT the meeting of the American Association, at New Haven, Professor Olmsted read a paper on some peculiar properties possessed by a compound formed of hog's lard and common rosin. He says, — "An accident first led me to observe something remarkable in this compound. Wishing to fit the brass plate of an old air-pump so as to make a close joint with the receiver, I had been accustomed to apply to the plate a disk of leather, saturated with lard. With the hope of rendering it more completely impenetrable to air, I added to the lard a small quantity of rosin, and melted them together. I expected the rosin would give greater hardness to the lard, and make it fill the pores of the leather more effectually, but was surprised to find that the change produced by the rosin was to impart to the lard a tendency to remain in the fluid state, so that, in a winter's day, the compound, when cold, remained in the state of a semi-fluid, at the temperature of a room moderately heated. I found, also, that this preparation, when applied to the leather of the air-pump, rendered it peculiarly soft, and, at the same time, very impermeable to air, so as to form a good joint with the receiver. But what more particularly arrested my attention was this, that, having inadvertently left the leather on the plate of the pump for nearly a year, during which time the use of the apparatus was discontinued, I supposed, when I took it out again, that I should find the brass plate much corroded, as I had sometimes seen it before, when exposed for a much less time to the action of the oiled disk of leather; but, on the contrary, the brass was entirely free from corrosion, and I have uniformly found the same to be the case since, however long the leather may have remained in contact with the plate. This observation suggested another and more important use of the same preparation for lubricating the pistons, which, being likewise of brass, and moving in brass barrels, had before occasioned me much inconvenience, by their liability to corrode by the action of the oil used for lubricating on the brass.

"I have recently made a few experiments, with the view of ascertaining the melting point of this compound, and the proportions of the ingredients which give the lowest melting point. The best proportions are, by weight, lard three parts, rosin one part. If the rosin

be added in fine powder, and the mixture well stirred (without the application of heat), it softens and so nearly approaches a fluid as to run freely when taken up on the stirring-rod, at a temperature of 72° . On melting the mixture, and setting it aside to cool, the following changes take place:—At 90° it remains transparent and limpid; at 87° , a pellicle begins to form on the surface, and soon after it begins to grow slightly viscid, and as the temperature descends, it passes through different degrees of viscosity, like oils of different qualities, until, at 76° , it becomes a dense semi-fluid. It is an unexpected result, that the addition of one part in four of rosin, whose melting point is near 300° , to lard, whose melting point is at 97° , should render it more fluid, reducing its melting point to 90° , imparting to it the properties of a semi-fluid, at a temperature as low as 76° , and even rendering the preparation of a softer consistency than lard itself, at a temperature as low as 60° . This compound of lard and rosin has, therefore, two somewhat remarkable properties:—It prevents in the lard, and probably in all the animal oils and fats, their tendency to generate an acid, and thus to undergo spontaneous decomposition. A much smaller proportion of rosin than one fourth gives to lard this property, destroying as it does the tendency of these substances to oxidation. Several important practical applications result from this property. Its use for lubricating surfaces of brass or copper has already been adverted to. It is equally applicable to surfaces of sheet-iron. I have found a very thin coating, applied with a brush, sufficient to preserve Russia-iron stoves and grates from rusting during summer, even in damp situations. I usually add to it a portion of black lead, and this preparation, when applied with a brush in the thinnest possible film, will be found a complete protection to sheet-iron stoves and pipes. The same property renders the compound of lard and rosin a valuable ingredient in the composition of shaving-soap. The quality of shaving-soap is greatly improved by a larger proportion of oil than is usually employed, so as completely to saturate the alkali; but such soap easily becomes rancid when wet with water, and suffered to remain damp, as it commonly is when in use. If a certain proportion of this compound is added to common Windsor soap (say one half its weight), the tendency to grow rancid is prevented. A very soft and agreeable shaving compound, or 'cream,' may be made by steaming in a close cup a cake of any common shaving-soap, so as to reduce it to a soft consistency, and then mixing intimately with it half its weight of our resinous preparation, adding a few drops of some odoriferous substance. The same compound forms an excellent water-proof paste for leather. Boots, when treated with it, will soon afterwards take the usual polish when blacked, and the soles may be saturated with it without danger of soiling the floor, as it does not rub off, while the leather is rendered, in a high degree, impervious to water. The perfect solution into which rosin passes when heated with oil suggested the possibility of improving, in this way, the quality of oils used for illumination, and, by its reducing the melting point of lard, to render that more suitable for burning in solar lamps. I therefore added powdered rosin to lard oil, in the propor-

tion of eight ounces of rosin to one gallon of oil, and applied a moderate heat, sufficient to produce perfect solution. I then filled two solar lamps, equal in all respects, the one with lard oil, the other with the same holding the rosin in solution, and regulated the flame, so as to be as nearly of the same size as possible. I measured, by the method of shadows, the comparative intensities of light, which I found to be as 7 to 5 in favor of the prepared oil. This burned with a flame of peculiar richness, plainly exceeding in density that from the simple oil, but after two hours the flame of the prepared oil began to decline slowly, and soon became inferior to the other, an effect which doubtless arose from the clogging of the wick. I had hoped, on account of the perfect solution which the rosin seemed to undergo, that the compound would burn freely without encountering this impediment; but in this respect I was disappointed, and can only say that, if some means can be devised for avoiding the tendency to clog the wick, the addition of a small portion of rosin to lamp-oil or lard will add essentially to its value for burning in solar lamps, by rendering it less liable to congeal, and by increasing its illuminating power.

FORMULA FOR AN INK THAT RESISTS THE ACTION OF ACIDS,
ALKALIES, WATER, OR ANY OF THOSE SUBSTANCES USUALLY
USED IN DEFACING WRITING.

SHELL-LAC 2 oz. ; borax 1 oz. ; distilled or rain water 18 oz. Boil the whole in a closely covered tin vessel, stirring it occasionally with a glass rod until the mixture has become homogeneous; filter when cold, and mix the fluid solution with an ounce of mucilage of gum Arabic prepared by dissolving 1 oz. of gum in 2 oz. of water, and add pulverized indigo and lampblack *ad libitum*. Boil the whole again in a covered vessel, and stir the fluid well to effect the complete solution and admixture of the gum Arabic. Stir it occasionally while it is cooling; and after it has remained undisturbed for two or three hours, that the excess of indigo and lampblack may subside, bottle it for use. The above ink for documentary purposes is invaluable, being, under all ordinary circumstances, indestructible. It is also particularly well adapted for the use of the laboratory. Five drops of creosote added to a pint of ordinary ink will effectually prevent its becoming mouldy.

GAS FROM WATER.

AFTER many partial and conflicting statements, we have at last minute detailed accounts of the manner in which a gas for burning is produced from water by Mr. H. M. Paine, of Worcester, Mass. These accounts are contained in the *Boston Chronotype*, *Springfield Republican*, and *Boston Transcript*, and it is from all of these that the following facts are derived.

Mr. Paine claims, among other things, to have discovered a means of increasing the power of a magneto-electric machine, to such an extent that he can decompose water rapidly with it; that he can take a jar of water, and, by means of the electricity induced by this ma-

chine, can convert *the whole of it into hydrogen gas* without the production of any oxygen whatever. He claims, also, that, by changing the electrical poles, he can convert the whole of the jar of water into *oxygen gas*, without producing any hydrogen; that, after producing the hydrogen, as above, and passing it through spirits of turpentine, it becomes *catalized*, and then will burn with a clear and brilliant flame, and this, too, without any loss to the turpentine by the passage of the gas through it. In regard to light, independent of the other applications of the power, Mr. Paine claims to have discovered a means of producing it from water, by electricity, at a cost infinitely less than any mode now in operation.

The apparatus employed is a common magneto-electric machine, consisting of two compound permanent horse-shoe magnets about 12 inches long, placed one above the other, and about four inches apart. Between their ends is a pair of *helices*, so attached to a wheel above that they can be put in rapid rotary motion. These helices are the chief peculiarity of the apparatus by which Mr. Paine claims that he increases enormously the electrical power of the magneto-electric machine. It is well known that the power of such a machine, with the ordinary helices, up to a certain point, depends upon the amount of surface of insulated copper-wire in the helices. It is only upon the surface of this wire that the electricity can be conducted. Mr. Paine's helices differ from the above in this, that the wire which forms the coil is made hollow, being formed by twisting or winding very thin strips of copper, forming it into a tube. This wire or tube is then covered with India-rubber or gutta-percha to insulate it, and filled with water. This water is so arranged as to be brought in contact with the current of electricity induced from the magnets in the same manner as the wire that surrounds it. It will thus be understood that the main secret of Mr. Paine's discovery is the introduction of *a coil of water into the coil of wire in the helix*. His helix, instead of being an insulated solid wire, is an insulated tubular wire filled with water, the water answering, as it were, the purpose of a reservoir for the accumulation of the electricity. In further carrying out this arrangement the pole-changer is so made that there is a discharge from each helix only once in three revolutions, by which the decomposing effect of the current is much enhanced. From the negative pole of the helices a copper wire passes to a large open-mouthed glass jar, partially filled with water. Within this jar is placed a bell-glass, open below, and reaching to within about four inches of its bottom; the top of the bell-glass is closed with a brass cap, resting upon the sides of the outer jar. The wire passes through this cap and nearly to the bottom of the bell-glass, terminating in a circular metallic box, which is hollow and perforated with small holes, and which contains the electrodes, where the electric current comes in contact with the water and decomposes it. The construction of these electrodes is peculiar. They are made of platinum, and differ from such as are commonly used in this respect. They present to each other a very large amount of surface and angles in close proximity. This is effected by having one electrode constructed like a honeycomb, and the other

with short wires or pins, which dip into the cells of the honeycomb. From the positive pole of the helices a second wire passes to a common glass tumbler partially filled with water. From this tumbler passes another wire (having no connection with that from the helices excepting through the water) also into the bell-glass, and so to the electrodes. The water having been decomposed and the gas formed, it rises to the top of the bell-glass, where it enters a tube, which conveys it to the bottom of a glass jar partially filled with spirits of turpentine. This latter jar also is covered by a cap, connected with which is another tube which conveys the gas to the burner where it is lighted. The reason given by Mr. Paine for interrupting the wire from the positive pole by the water in the small glass is, that unless this is done both hydrogen and oxygen are generated in the bell-glass.

This is all the apparatus. When it is set in operation, the gas is generated, but there seems to be much difference of opinion as to the rapidity of its production. A letter to the *Editors* from a gentleman who has examined the matter says, that, from observations made on the spot and subsequent experiments, he is satisfied that the machine examined only produced sufficient gas to supply a single burner with an aperture of about one thirty-third of an inch, which would discharge one and three quarters cubic feet of gas per hour, and this, too, at a time when Mr. Paine assured him that the machine was doing all that it was capable of doing. Mr. P., however, claims that at that time it was producing sufficient gas to supply 100 burners, equal to about 350 cubic feet per hour. It will thus be seen, that upon this vital point there is much difference of opinion. By burning the gas before it reached the turpentine, it appeared to be simple hydrogen gas, though Mr. Paine says it differs somewhat from that; but when lighted after passing through the turpentine, it produced a dense white flame, perfectly defined in its form, as seen in a room brightly lighted by the sun. The whole apparatus was carefully examined, and all the writers agree in saying that it is impossible that there could have been any deception, and that the light produced must have been from the consumption of the gas generated by the revolution of the helices.

It is evident that the question, whether the turpentine is consumed by the passage of the gas through it is a very important one; in fact, one upon which the value of the discovery, in an economical point of view, must depend. Upon this point there is a want of information, all the descriptions having come from persons who have examined the matter only for a short time. Mr. Paine maintains that the turpentine undergoes no consumption, but that the gas in its passage through it is *catalized*, or changed from simple hydrogen to a more illuminating gas by *contact* or *presence*, without detracting from the turpentine any of its original properties, an effect by no means without a parallel in chemistry. The other view is, that the gas is carburetted, in which case the turpentine must be so rapidly consumed, that, as a generator of light, it would be comparatively useless. This latter view is strongly supported by the fact that, after the gas has been passed through the turpentine, it is observed to have acquired a strong odor of

turpentine. Even in this case, however, it is claimed that it may be advantageously used in the production of heat.

Some of the obvious consequences following from the above discovery are so contrary to all received views, that they have led many to doubt the reality of the discovery, and it is evident that, if it is all that is claimed, there remain many phenomena to be explained, the chief one being the entire absence of the oxygen when the hydrogen is generated for burning.

GASEOUS TRANSFORMATION OF WATER.

At the meeting of the Royal Society on Jan. 24, a communication was read from M. Daniel Paret, "on the gaseous transformation of water, by means of a pile in two separate compartments, having no other electric communication between them besides conducting-wires of copper, and giving in the one oxygen alone, and hydrogen alone in the other." After premising that, at the present time, it is the generally received opinion that water is a compound of oxygen and hydrogen, the author states that he now brings forward an experiment which proves, not that water is a compound, but really a simple element, the generator of oxygen and hydrogen, since, without being decomposed, a given volume of water may be entirely transformed at will, either into oxygen or hydrogen. Thus, he considers, it is no longer a decomposition of preëxisting elements which is effected, but really a gaseous transformation into two "sub-elements," which are formed at the expense of the water, by the transposition of its combined or coercitive electricity, which places itself in excess in the water which becomes oxygen, at the expense of another volume which becomes hydrogen. However astonishing this may appear, it is "*un fait accompli et acquis à la science.*" After describing the experiments which he considers as supporting his doctrine, the author observes that "these experiments prove, — 1. That, contrary to the indefensible theory, a compound electric fluid which is decomposed and recomposed, there is a true transfer of fluid in the current, which, besides, would be sufficiently evident by its motive power. 2. That the electric fluid is really the coercitive agent of cohesion. 3. That water is not a compound, is not an oxide, but truly a first element, the generator of oxygen and hydrogen. 4. In fine, it reveals a body unknown until now, and very likely many other bodies are in the same condition as water." — *Proc. Royal Society.*

ON THE SPHEROIDAL STATE OF BODIES.

At a meeting of the American Academy in November, Prof. Horsford read a paper on the spheroidal state of bodies, of which the following is an abstract. From the earlier observations of Leidenfrost, and the later extended researches of Boutigny,* upon the so-called spheroidal state of bodies, much attention has been directed to the phe-

* See *Annual of Scientific Discovery*, 1850, pp. 196 – 198.

nomena considered under this name, and to the speculation, that a new law superseding the ordinary laws of heat was here illustrated. The object of the communication was principally to show, that these phenomena are not at all rare, and that they require no new law for their explanation. In the experiment of dropping water upon a hot polished metallic surface, we have three bodies concerned in the phenomena that follow; viz. the supporting surface, the water, and the layer of vapor interposed between. The water rests upon a cushion of steam continuously evolved by heat from the water, and assumes rounded margins as the result of the gravity of its particles towards its own centre. Its condition approximates to that of a liquid entirely surrounded by a uniformly yielding elastic medium, as a drop of molten lead in air, for example, and permits a proportional approximation to the spheroidal form. It is essential only that there be two bodies, one of which must be fluid, and between which affinity is wanting; elevated temperature is not necessary. Corresponding with water is the ordinary experiment known by the name of Leidenfrost; ether, alcohol, a variety of essential oils, etc., may be employed. The conditions are the same; the liquid evolves a vapor, which, constantly issuing, prevents contact with the supporting surface. Here are three bodies and a high temperature. Ether and oil dropped on water assume the spheroidal state. They have no affinity for the water. Here but two bodies and no heat are required. Quicksilver upon glass, and also water upon glass covered with fine dust, take on the spheroidal state. Potassium thrown upon water assumes this state. In the decomposition of the water producing potassa, hydrogen is evolved, and with the heat arising from this union and that of the potassa with water, forming hydrate of potassa, water is vaporized, which with the hydrogen keep the floating sphere and water apart. The dew-drop presents the spheroidal, but little differing from the spherical, state. It rests in most cases upon the hair or down with which leaves are covered, and is not in contact with the leaves or twigs. The bead, as it is called, which appears at the surface of some liquids when violently shaken, and of which we have a familiar example on the water around the prow of an advancing sail-boat, is an instance of the spheroidal state of great interest; what prevents the prompt reunion of the bead with the mass is not so obvious.

There is a fact in the history of the barometer, noticed by Prof. Guyot, which may have some influence in explaining this phenomenon. When pure mercury is introduced into a barometer tube, and afterwards boiled, so as to expel all air, upon erecting the tube in the cistern, the top of the column presents a certain curve, — the meniscus, — the character of which is dependent on the composition of the glass and the diameter of the tube. If now a bubble of air be introduced and then carefully removed, on erecting the barometer again, the mercury will stand at the same elevation as before, but the meniscus will be less convex. Here, as in the case of the bead, it may be conceived that the mercury and water have condensed an infinitely thin layer of air upon their surfaces, which provides for the phenomena of the spheroidal state in the latter instance, and which modifies the affinity of the mercury for the glass in the former.

Of this class of facts, to none has more interest attached than to the recent experiments of Boutigny with molten metals. To him are we indebted for the first scientific consideration of this subject, although it appears that jugglers performed the feat of washing the hands in molten lead many years ago, and the act of plunging the bare hand into molten iron is an experiment which has been performed by furnace men in this country for at least twenty years. In one instance, the feat of plunging the hand into a pot of melted iron, and of placing a red-hot iron upon the tongue had become so common, as to cease to excite curiosity. In the experiment of passing the fingers into molten iron, which I have repeatedly performed without the slightest discomfort, it is necessary only, as noticed by Boutigny, that the surface of the skin should be wet, or covered with some body like powdered resin, which upon the application of heat will readily vaporize. That the experiment may be safely performed, any one may satisfy himself, by passing through the molten mass any highly combustible substance previously moistened. It will not be affected by the heat. The experiment with melted lead is less satisfactory than with molten iron, because the temperature is lower; it will, however, satisfactorily show the character of the phenomenon.

When the hand is passed into the liquid metal, the vapor is vaporized, interposing between the metal and the skin a sheath of vapor. In its conversion into vapor the water absorbs heat, and thus still further protects the skin. The explanation of Berzelius, offered some years since, and confirmed by all the experiments, so far as I know, that have ever been performed, is the following. In the Leidenfrost experiment a layer of vapor continually evolved from the inferior surface of the liquid provides an aeriform medium which does not conduct, but merely transmits, radiant heat, which, passing through the liquid, as through most transparent substances, heats it but slightly. Thus evaporation is slow. The temperature of the liquid, it is well known, remains constantly below that of the boiling point. This accounts for the much greater length of time required for water to evaporate when resting upon an oiled surface, than when in contact with wood or metal; and for the length of time that dew-drops on spiders' webs will sustain exposure to the air, when compared with that which would be required to evaporate an equal quantity of water from a leaf surface, where there is actual contact, and where conduction makes it take place.

The explosions sometimes following the first contact of a piece of potassium with water are due to the admixture of evolved hydrogen and atmospheric air. The explosion at the conclusion of the experiment is of another character. It is due to the sudden contact of the hydrate of potassa with the water, when the temperature has become sufficiently low to permit it, and is analogous to the phenomena witnessed when the surface supporting a mass of water in a spheroidal state is permitted to cool down until contact takes place. The explosions occasionally witnessed when large quantities of fused saltpetre have come in contact with water, are of this description. The explosions of steam-boilers have recently, in several instances, been ascribed

to the properties of steam evolved from water in a spheroidal state, or evolved at the instant contact with the water and boiler is resumed. This has been called highly explosive steam. It is conceived that in some way the mass of water in a boiler becomes separated from the interior surface of the metal, as in the experiments of Leidenfrost, and that upon cooling down to about 300° F. contact is resumed, and from the sudden evolution of steam explosions result. But any boiler of ordinary strength would sustain any pressure which could be exerted from any amount of steam produced within its own walls at a temperature of 300° F., and, by conditions supposed, water in the boiler has been already more highly heated, else it could not have been cooled down to this temperature; a higher heat must have subjected the boiler to greater pressure, and yet that pressure was sustained. — *Editors.*

In some experiments made at Paris during the past year, it has been observed that, if the hand be first moistened with ether, it may be plunged into boiling water with impunity. — *Ibid.*

THEORY OF THE SPHEROIDAL STATE OF BODIES.

M. BOUTIGNY has presented to the French Academy a paper on the theory of the spheroidal state of bodies,* from which the following is an extract. "The diversity of opinion existing as to the cause of the tendency of bodies to assume the spheroidal state, induced me to make the following experiments. I rolled in a spiral form a platinum wire of 0^m.001 in diameter, so as to make a sort of sieve with continuous circular meshes. I then poured into this vessel water, alcohol, and ether successively; and, as may be supposed, these three liquids ran through the meshes of the vessel. This fact ascertained, I made the vessel red-hot, and repeated the experiment; but the liquids no longer passed through the meshes of the sieve, but could actually be removed from place to place, as if in a close vessel. As to the alcohol and ether, I observed that the vapor they generated (its density being considerably higher than that of the air) formed an equilibrium, up to a certain point, with the ascending current of hot air produced by the high temperature of the vessel, and this vapor, escaping through the meshes of the vessel, ignited above and below; thus the spheroid of liquid became interposed between the bases of two cones of flame. Thence it is clear that the vapor, escaping freely and uniformly from the whole surface of the spheroid, would not be adequate to produce a reaction sufficient to neutralize the influence of gravity, and to maintain the spheroid beyond the sphere of physical and chemical activity. In repeating the preceding experiment with iodine, it is still more conclusive. The lower cone of flame is replaced by a beautiful column of violet vapor, which falls through the meshes of the sieve, immediately underneath the spheroid of iodine. These experiments appear to me to establish fully the existence of this mysterious repellent power which neutralizes the action of gravity." — *Moniteur Industriel.*

This paper has been made the subject of a report from Babinet,

* See *Annual of Scientific Discovery*, 1850, p. 196.

Despretz, and Becquerel, in which the views of M. Boutigny are approved.

INFLUENCE OF OZONE.

In the village of Roggendorf, in Mecklenburg, towards the end of 1846, slight catarrhal affections were prevalent; the air at that time contained only slight traces of ozone. At the commencement of the year 1847, these affections assumed the most serious forms of bronchial and catarrhal diseases, and whooping-cough affected a large proportion of the population. At this period there was perceived a considerable increase in the proportion of ozone contained in the atmosphere, and influenza was immediately developed. On the 9th of January, the ozonometer showed a still greater increase in the proportion of ozone in the air; the same day ten persons died of the influenza, and the disease gradually progressed to such an extent, that on the 21st few persons had escaped it. During all this time there was a perfect connection between the presence of ozone and the propagation of the disease. Since sulphurous vapors prevent entirely the formation of ozone, it follows that the workmen employed in manufactories in which sulphur is concerned should escape this influenza. M. Splenger has fully proved that this is really the case. — *Höule Zeitschrift*.

OZONE.

BECCEREL has laid before the French Academy the following experiments and observations on ozone, communicated to him by Schönbein, its original discoverer. Schönbein procures a large quantity of ozonized air by putting into a receiver of the capacity of 10 or 12 litres ($4\frac{1}{2}$ litres being equal to one English gallon), a small quantity of water and sticks of phosphorus, one half of the sticks being immersed in the water, and the other half exposed to the air. The air of the receiver is then heated from 59° to 68° F., and imperfectly closed. When the operation is finished, which is ascertained by the odor of the ozonized air, the receiver is inverted in a vessel of water, to get rid of the sticks of phosphorus, and is then removed and shaken, in order to wash the compound. This operation being finished, a cork is fitted to the receiver into which two tubes are passed, one for the conveyance of water, and the other to conduct the ozonized air into vessels containing the substances to be submitted to its action. Ozone is also formed when the vapor of phosphorus and water is mixed with oxygen gas. It does not form at the same temperature in pure and dry oxygen; it is the same in pure and humid oxygen at the usual atmospheric temperature and pressure. Phosphorus placed in moist oxygen produces ozone at common temperatures, if the air be sufficiently rarefied. Phosphorus, in humid oxygen at common pressures, gives rise to ozone when the temperature is raised to 75° F.; and its formation takes place rapidly at 86° F. The presence of certain gases in the oxygen produces the same effect as rarefaction, or increase of

temperature. Of all gases, hydrogen is that which produces this effect in the highest degree; then follow nitrogen and carbonic acid. In a mixture of four parts of hydrogen to one of oxygen, as moist as possible, the formation of ozone is so rapid at 60° to 68° F., that, on account of the action occasioned by this body on the phosphorus, this substance and the explosive mixture inflame. Ozone is not formed in moist air at 32° F.; the formation begins to be perceptible at 42° to 46° F.; at 60° to 68° it is rapid, and occurs without danger. No effect takes place at common temperatures when the air is compressed to a fifth or a sixth; to obtain any action under these circumstances, the temperature must be raised. The presence of certain gases, such as olefiant gas, and nitrous vapors, in humid oxygen, when sufficiently rarefied, and also in air, obstructs the formation of ozone. According to Schönbein, when the vapor of ether is slowly burnt in air or in oxygen, there is formed, among other products, a compound of ozone and olefiant gas.

When ozone is passed through a tube heated to 482° F., it is stated by Schönbein to be entirely destroyed. (Prof. Horsford has shown that ozone heated under the same circumstances to only 130° F. entirely loses its properties. — *Editors*.) The same is the case at common temperatures with charcoal. Air which is strongly impregnated with ozone impedes respiration, and produces catarrhal affections; small animals are quickly killed by it; it quickly destroys organic coloring matter, and also ligneous and albuminous substances. Pure and fresh albumen remains unaffected by it. It combines chemically with chlorine, bromine, and iodine when water is present, chloric, bromic, and iodic acids being formed. Strongly ozonized atmospheric air, when exposed to lime-water, produces appreciable quantities of nitrate of lime. It may be stated, generally, that nascent ozone, when in contact with nitrogen and a strong base, produces nitric acid; a small quantity of nitric acid is also formed during the slow combustion of phosphorus in the air. Ozone acts powerfully upon most metals, causing them to assume their maximum of oxidation; the action commences at 32° F. (It also rapidly destroys India-rubber. — *Editors*.) Ozone combines directly with olefiant gas without decomposition; it destroys sulphuretted and seleniuretted hydrogen, water being formed with the hydrogen of the acid, and sulphur being set free. It converts nitrous and sulphurous acids into nitric and sulphuric acids.

Ozone precipitates peroxide of lead from an alkaline solution of lead, or from the acetate. It rapidly decomposes all the salts of manganese, whether in a solid state or in that of solution, producing peroxide. Hence it results that a strip of dry paper impregnated with sulphate or chloride of manganese is a reagent for ozone, the paper becoming rapidly brown in an ozonized atmosphere. The best reagent is a strip of paper coated with starch-paste and iodide of potassium. A solution of yellow ferrocyanide of potassium is changed by ozone into red cyanide of potassium. A great number of metallic sulphurets are rapidly converted by this substance into sulphates; such are the sulphurets of iron, lead, copper, and antimony. According to M. Schönbein, ozone is the most powerful oxidizing agent in nature. As

ozone is invariably formed in the air by the action of artificial electrical discharges, it should also be produced throughout the atmosphere, in which natural electrical discharges occur. Nothing is easier than to demonstrate the presence of ozone in the atmosphere, and the variations of the quantities produced, by means of the test-papers described. In general, the reaction is greater in winter than in summer. Schönbein has always remarked that, during a fall of snow, it is much greater than at any other time. An exposure of iodized and starch paper for two hours is sufficient to render it of a deep blue color, whereas the same air inclosed in a receiver produces no effect. It may be inquired whether the nitric acid which is formed by passing electric sparks through air, as first observed by Cavendish, and also that produced by storms, are due to the direct action of electricity on oxygen and nitrogen, or to that of ozone on nitrogen. (It has been suggested, that the well-known fact of the souring of milk during thunder-storms may be attributed to the action of ozone formed by electrical action. — *Editors.*) Such are the general properties of a substance, the composition of which has hitherto escaped all methods of analysis, and which M. Marignac considers as a peculiar modification of oxygen, which increases its chemical affinities. Schönbein regards it as a compound containing more oxygen than oxygenated water. But all these are merely hypotheses which require the sanction of fresh experiments. Opinion as to the nature of the substance should not yet be pronounced. — *Comptes Rendus*, Jan. 14.

Atomic Weight of Ozone. — In *Poggendorff's Annalen*, Osann publishes some additional researches on the atomic weight of ozone. When ozonized air is passed through a solution of nitrate of silver in ammonia, a black precipitate forms. This precipitate, after being well washed and dried, yields on reduction by hydrogen 97.56 of silver to 2.44 of oxygen; so that an oxide of silver appears to exist having the composition of Ag^3O (which differs from the oxide discovered by Wöhler, Ag^2O). If the ammoniacal nitrate of silver solution is exposed to the air, there is formed in the course of a few weeks a thin saline crust at the margin of the liquid, which is blackened, and apparently contains the same oxide. This phenomenon exactly corresponds with the behaviour of starch moistened with a solution of iodide of potassium, which likewise turns blue in time by exposure. As no analogous compound of silver and oxygen has been before obtained, the inquiry is reasonably made, Is the black precipitate experimented on in reality an oxide of silver, or a compound of silver with a peculiar and new substance, ozone? This latter conjecture Osann is inclined to adopt, and calls the body for the present ozone-oxygen. Supposing it to be a distinct body, it must have a separate atomic weight, and this is found from its compounds with silver and lead to be between 5.63 and 6.10. Various experiments seem to show that ozone-oxygen has a definite atomic weight; that it is by no means a modification of oxygen, but a peculiar substance like chlorine, bromine, &c., but whether of a simple or compound nature cannot be stated. If it be admitted that ozone-oxygen is a distinct body, this will explain in a most simple manner how oxide of lead is precipitated by ozone

from its solution in potash, and a precipitate of silver is obtained from a solution of nitrate of silver in ammonia. Osann has also given considerable attention to ozonized air, and that mixture obtained by passing air over phosphorus, transmitting it first through a solution of iodide of potassium, and then, when freed from ozone in this manner, collecting it in a glass vessel. As soon as this was filled, the operation was discontinued. After about twenty-four hours, the white vapor had disappeared, and the water closing the bell-glass had an acid reaction. Mixed with lime-water no precipitate resulted, but on boiling the liquid a white powder separated, whence it follows that this substance is phosphorous acid. It would at the same time follow that there are two modifications of phosphorous acid; one of which resists combination with water, and the other not. Now, says Osann, if ozone is only a modification of oxygen (active oxygen), it must be distinguished from the passive modification, as is done for these conditions in other bodies. The same would also apply to phosphorous acid, and it would then be worthy of remark, that, in the preparation of ozone by means of oxygen, the phosphorous acid is converted into the passive, and the oxygen into the active modification.

Connection of Ozone and Diseases. — Considerable attention having been drawn, during the summer of 1849, to the subject of the influence of ozone, from a fancied connection between it and the cause of the Asiatic cholera, the following suggestive thoughts have been published by Robert Hunt, of London. He says, — “All living animals and vegetables are constantly throwing off from their bodies organic matter in a condition the most fitted for recombination with the chemical elements of the air. The gaseous exhalations from all dead matter are constantly combined with organic particles in a state of extreme division. Thus, the atmosphere is constantly receiving exhalations from the earth and its inhabitants, which, without a provision for their removal, would speedily become far more injurious to all forms of life than carbonic acid; though to that alone we have been in the habit of too commonly attributing atmospheric deterioration. Ozone, then, in the opinion of Mr. Hunt, is the great natural agent employed to convert all those deleterious exhalations which the air receives into innocuous matter. An atmosphere artificially charged with ozone immediately deprives the most putrid solid or fluid bodies of all disagreeable smell, and sulphuretted hydrogen is instantly decomposed by it. In fact, its action upon organic matter is far more energetic than that of chlorine.

“It has been proved that the electrical intensity of the atmosphere was, during the prevalence of the cholera in 1849, diminished in a remarkable manner. At St. Petersburg magnets lost their power, and in Paris electrical machines would not give out sparks during the ascendancy of the cholera in those cities. Quetelet has proved that the electrical intensity of the atmosphere was, during the whole year, about one half that observed during former years, and that from the 1st of January, 1849, up to a certain period, it regularly diminished, and appeared for some time stationary. As electricity is a great cause, ever active, in producing ozone, we might *a priori* infer

a relatively diminished quantity of this chemical agent, and experiment has proved that, during the three months previous to August, an appreciable quantity of ozone could not be detected by the ordinary methods in the air of London. Certain, then, it is, that, during the prevalence of the cholera, we had an atmosphere of low electrical intensity deficient in ozone, — an agent which would remove, or alter, pestilential miasma." Ozone is formed generally during the process of combustion, and it is well known that large fires have again and again proved effectual in stopping the plague, and like pestilences.

INFLUENCE OF THE SOLAR RAY UPON OXYGEN.

At the meeting of the Swiss Association for the Advancement of Science, Professor Schönbein communicated the result of experiments recently made by him on the influence exerted by solar light on the chemical action of oxygen. From various causes, he was led to suppose that the chemical powers or affinities of oxygen are exalted by light, independently of heat. To test the correctness of that conjecture by experiment, he put a number of inorganic oxidizable matters in contact either with pure oxygen or with atmospheric air, — both being subjected to the action of direct solar light. He found that either pure or atmospheric oxygen, being isolated, readily unites with sulphurets of lead, arsenic, and antimony, all other circumstances, temperature, &c. remaining the same. Moisture, though accelerating the action, is not required to be present in oxygen, in order to obtain the results mentioned. Hence it comes that bands of paper colored brown or yellow by the sulphurets named are completely bleached when exposed to the combined action of solar light and atmospheric air. According to Schönbein's experiments, lead paper is by far the most sensitive to sunlight; then comes sulphuret of arsenic paper, and, last, sulphuret of antimony paper. As regards the lead paper, it is so sensitive that, if it be but slightly colored, it will within fifteen minutes be turned white in a strong noon sun of June or July. On account of that sensitiveness the sulphuret of lead paper is a sort of photographic paper, and may be used to produce drawings, &c. Professor Schönbein exhibited to the Association a number of such photographic productions, and also copies of prints which he obtained by simply putting those prints upon sheets of sulphuret of lead paper, and exposing the whole for hours to the joint action of direct solar light and atmospheric air. Though diffused light acts sensibly upon the lead paper, its action in the camera is too feeble to produce an appreciable effect. If by some means the sensitiveness of the paper could be much increased, positive images would be obtained. Schönbein does not, however, lay any stress on his discovery in a photographic point of view, its principle appearing to him infinitely more important than its applicability to photographic purposes. But he is inclined to think that, by means of sulphuret of lead paper, a good chemical photometer might be made. Besides the sulphurets mentioned, Professor Schönbein has under solar influence oxidized some other matters capable of taking up oxygen; for instance, he has trans-

formed the common oxide of lead into a compound of that base with peroxide of lead, &c. As far as his experiments go, they prove beyond a doubt that in a number of cases isolated oxygen produces the same oxidizing effects as ozonized air or oxygen. He is, therefore, inclined to think that light independent of heat exalts the chemical affinities of oxygen, and that the slow oxidations which a variety of organic and inorganic matters undergo in the open air are, in part at least, due to the exciting influence excited by solar light upon atmospheric oxygen. Common bleaching is, of course, an instance of that sort of oxidation. But Professor Schönbein goes still farther in his conjectures as to the part which isolated atmospheric oxygen acts in the economy of nature. He entertains the notion that the production of electricity by clouds is intimately connected with the chemical powers developed in atmospheric oxygen by solar light; i. e. he presumes that electricity has a voltaic origin resulting from an electro-motive action of isolated oxygen on atmospheric moisture. — *Athenæum*, Nov.

DISCOLORATION OF SILVER BY BOILED EGGS.

It is well known that silver, when brought in contact with eggs which have been heated, is blackened, and that this discoloration is owing to sulphuret of silver. It is usually admitted that this sulphuret is formed by the action of the sulphuretted oils supposed to exist in the yolk of the egg. M. Goble, not having found in this body any thing of this nature, proceeded to examine into the causes of the phenomenon. He found that the yolk of an egg at the common temperature, and also when heated, does not discolor silver, even by contact of several hours' duration. He farther found that albumen, as procured from the egg, does not tarnish silver, but when heated it gives it a brown tint, which is stronger as the heat is greater. He therefore concludes that the discoloration of the silver is due to the sulphur contained in the albumen, and not to that supposed to exist in the yolk. By other experiments, he has ascertained that the sulphuret thus formed is not the result of the immediate action of the sulphur upon the silver, but by the application of heat the sulphur and the alkali of the albuminous matter react upon each other so as to form a substance which is afterwards decomposed by this metal.

GEOLOGY.

CHANGE OF LEVEL IN THE SEA-COAST OF THE UNITED STATES.

At the meeting of the American Academy in February, a report was adopted, requesting the Secretary of the Treasury to instruct the Superintendent of the Coast Survey to cause suitable observations to be made, and permanent monuments to be established at suitable intervals along the eastern and western coasts of the United States, in order to determine whether any changes in the relative level of the land and sea take place; and whether such changes, if they do take place, are general or local, and whether there is any thing like a balance movement in this continent, whereby one coast rises while another sinks. The committee presenting the report, consider the establishment of land-marks at measured heights above the mean sea level as highly important, because the whole eastern coast of the United States exhibits evidence of a gradual rise of the land during the most recent geological periods, in the deposits of recent marine shells, which are to be seen undisturbed in their natural position, many feet above the highest tides. There are, moreover, direct indications of a gradual rise of the land actually in progress on and around the island of Newfoundland, and similar indications, it is thought, may also be traced along the coast of Maine. In compliance with the request, the Treasury Department has authorized the Superintendent of the Coast Survey to cause the necessary observations to be made, and the results communicated to the Academy.

CHANGES OF THE RELATIVE LEVEL OF THE SEA AND LAND IN VARIOUS PORTIONS OF THE WORLD.

In Scandinavia. — At the conclusion of an elaborate paper in *Jamieson's Journal* for January, on "changes of the relative level of sea and land in Scandinavia," Robert Chambers says, — "The general fact may now be considered as tolerably certain, that there is a district in Finmark, of 40 geographical miles in extent, which has sunk 58 feet at one extremity, and risen 96 at the other. Its line of dip

and of rise is not greatly different from that of the magnetic meridian for the district, which is about 11° west of north." As a general thing, the movement has been surprisingly equable over relative proportions of the space. There is a large tract in the south and east of Scandinavia, which is ascertained to be undergoing an elevatory movement, even at the present day. Thus, on the stone at Löfsgrund, which has been marked with the height of the water at various periods, but lastly by Lyell, in 1834, Mr. Chambers found the mark of Mr. L. 2 feet 7 inches below that of 1731, and the sea was already about 6 inches below that of Lyell, or over 3 feet below that made 118 years before. On another stone Mr. C. found a mark made in 1820, 11 inches above the present level of the sea, thus indicating rise of the land to that amount since that period.

In Abyssinia.—M. d'Hericourt, at the close of a memoir presented to the French Academy, on January 14th, concludes, from various reasons which he gives, that "the Gulf of Arabia and Abyssinia are in a constant state of elevation."

Subsidence Caused by Drainage.—Mr. G. W. Ormerod stated to the British Association, at Edinburgh, that the surface of Chat Moss, in Lancastershire, was shown, by a series of levellings made in the last four years, over an extent of about 200 acres, where drainage was carried on, to have subsided to the amount of one inch per annum.—*London Athenæum, Aug.*

SUGGESTIONS ON THE CHANGES OF LEVEL IN NORTH AMERICA DURING THE DRIFT PERIOD.

AT the meeting of the American Association at New Haven, Professor C. B. Adams presented a communication on the above subject. The objections to the glacial theory lie against the origin of the required glacial sheet rather than against the dynamics of the theory; while the objections to the other theories lie against their dynamics with a serious, if not with a fatal force. The suggestion, therefore, of a possible cause of a vast glacial sheet, 5,000 feet thick, may not be useless, even if somewhat improbable. The hypothesis is this, that the glacial sheet was produced by a great elevation of land in the northern regions above the present level. Besides the direct refrigerating influence of elevation, the flow of the tropical waters into the North Atlantic may have been essentially diminished by the contraction of the area of the ocean. This contraction must have been much greater, if, as is highly probable, the similar elevation of Northern Europe was synchronous with that of North America. Whether or not this elevation can account for the origin of the glacial sheet, there is direct evidence of a greater elevation than the present during the drift period, in the continuation of the drift striæ beneath the sea level; for it is well known that glaciers cannot advance into the sea. Unfortunately, the impossibility of following the striæ excludes us from the knowledge of the most important fact, the greatest depth at which striæ exist. The passage of drift materials across basins which are now filled with water suggests the same conclusion. Such of the

materials of Cape Cod, Nantucket, and Long Island, as could not have been taken from the mainland by marine agencies, must have been carried by glacial agency, and consequently the intervening basins must have been above the sea level. The passage of the glacial sheet across the basin of Lake Superior presents some difficulties, which are diminished by the theory of elevation. The bottom of this basin is now, at least, one hundred and sixty-five feet beneath the sea level. Without elevation, drainage would have been impossible.

It is easy to ascertain approximately the amount of submergence which closed the glacial period. Submergence to a depth of not less than two thousand feet below the present level effected the dissolution of the glaciers, and introduced the pliocene period. 1. The general proof of such submergence is the present existence of altered drift at a corresponding elevation. 2. Special proof is found in the existence of osars at great elevations. A semicircular one, well characterized, occurs in the town of Peru, Vt., at an elevation of between one and two thousand feet. 3. Other special proof may be found in the lines of ancient sea margins, which are much more rare than the fluvial terraces of a later date. Such a margin was found by President Hitchcock in Pelham, Mass., at an elevation of one thousand two hundred feet. 4. The most forcible argument is derived from the existence of regular stratified deposits of fine sand and clay at the summit level of longitudinal valleys.

ON THE SUBSIDENCE OF THE ISLAND OF NEWFOUNDLAND.

AT the Boston Natural History Society, December, Mr. Perley, Government Commissioner for New Brunswick and Canada, in reply to a question, stated that it was a well-known fact that the harbours on the south and east side of Newfoundland are deepening, while on the upper shore they are growing shallow; harbours which twenty years ago were deep enough for large vessels now hardly answering for shallows. On the south side of the island of Grand Manan, there was formerly a marsh covered with trees, which were cut down by persons now living. The marsh has sunk so much, that the stumps of those trees may now be seen eight or nine feet under water at low tide. Mr. Desor quoted from recollection a statement in *Poggendorff's Annalen* for 1849, that the shores of Newfoundland, in the vicinity of Conception Bay, are in the process of elevation. It was interesting to know that a corresponding process of depression is going on, as it would give confirmation to Mr. Dana's views with regard to the changes of level in the Pacific; he having stated that a rise in one place is always attended by a subsidence in another. Mr. Desor also referred to a statement which had been made formerly by Dr. C. T. Jackson, that the inhabitants on the coast of Maine believe that the rocks on the sea-shore are growing. Prof. Wyman remarked that, while on a visit to Labrador two years since, he had noticed on the shores of Great Macataney, shingle, pebbles, and rounded rocks, for a long distance, far above high-water-mark. He had noticed the same thing at Bras d'Or and Red Bay. At Red Bay is a large accumulation of the remains of

whales in a similar position. It is not known whether they were carried there or washed up by the tide. Many of them are so bulky, as to make it improbable that they were transported by hand. They are covered with moss, and bear marks of great age. None of the inhabitants in the vicinity are acquainted with their history. They are possibly the remains of whales captured by the Royal Fishing Company of Miscoe in the seventeenth century.

Mr. Perley stated that on the north side of the island of Grand Manan the land is very high, and there is but one harbour, known as "Dark Harbour." A century since, this harbour was accessible to vessels. Of late years the entrance to it has been cut off by a natural sea wall, which has formed across it, — say fifty yards wide and forty feet high. Three years since an opening was cut through it by the British government for the admission of vessels. Before this was done, the water within the wall was eight feet lower than it is now. Excellent fishing is found in the harbour. The water, which was salt at the time the opening was made, has shoaled so much as to make it necessary to deepen the passage. — *Proc. Nat. His. Soc., Dec.*

RELATIVE LEVEL OF THE CASPIAN AND BLACK SEAS.

THE *Comptes Rendus* for May 6 contains a letter from M. Struve, the well-known Russian astronomer, detailing the results obtained by him from an examination of geodetic and astronomical observations made in 1836 and 1837, with great care and very accurate instruments, for the purpose of ascertaining the relative level of the Caspian Sea, which is without any visible communication with the ocean, and the Black Sea, which has such a communication through the Mediterranean. A solution of this problem has been attempted several times before, but the results obtained are so discordant as to be entitled to little confidence, and the present investigation was undertaken with a view of finally settling the question. The result arrived at is, that "for October, 1837, the mean level of the Caspian Sea was 84.45 English feet below that of the Black Sea, and that this result is subject to a probable error of 0.83 of a foot."

ORIGIN OF THE GENERAL FEATURES OF THE PACIFIC.

PROF. DANA, in his work on the Geology of the Pacific, which forms one of the series of the publications of the Exploring Expedition, gives a theory of the origin of the general features of the Pacific, with the bearing of the facts upon the physiognomic peculiarities of the globe. His theory is enunciated in seven propositions.

First. This theory supposes a gradual solidification of the surface of the earth after the fluid material had lost its fluidity. Secondly. Contraction, as a consequence of solidification, was attended by a diminution of the earth's oblateness. Thirdly. There were fissures and displacements of the crust, owing to the contraction below it drawing it down into a smaller and smaller arc; also from a change in the earth's oblateness. Fourthly. There would be escapes of heat and melted

matter from below through the opened fissures. Fifthly. Earthquakes, or a vibration of the earth's crust, would be consequent on a rupture, internal or external, and would cause vibrations of the sea, besides other effects. Sixthly. These changes would make epochs in geological history. Seventhly. The courses of mountains and coast lines, and the general form of continents, were determined to a great extent by the general direction of the earth's cleavage structure, and the position of the large areas of the greatest contraction.

ELEVATION OF AN ISLAND IN LAKE SUPERIOR.

THE *Lake Superior Journal* states that, on June 18th, in the vicinity of Two Heart River, a slight agitation of the water was perceived near the shore, and soon a small round island, about 150 feet in circumference, was raised six feet above the water. The new island was at first covered with sand and pebbles, but the waves have dashed over it since, and washed it down to a black clay. The immediate shore was at the same time raised up about twelve feet, but a few rods back a circular spot of ground suddenly sunk down twenty feet. No noise or agitation of the earth was perceived.

CONNECTION BETWEEN AMERICAN AND EUROPEAN GEOLOGICAL FORMATIONS.

At a meeting of the Boston Society of Natural History, in February, Prof. Wyman exhibited specimens of fossil teeth from the tertiary deposit of Richmond, Va. They belonged to the genus *Phyllodus*, and possessed an unusual form. Prof. Rogers said he considered these specimens particularly interesting, as illustrating the fact that the eocene and miocene deposits of Europe are not parallel with, and equivalent to, those of America. The genus *Phyllodus* occurs in the London clay, eocene, while the Richmond deposit is considered miocene. The eocene and miocene of Europe are more closely related to each other than the layers of tertiary in America. Mr. Desor remarked that the London clay had been regarded of late by some geologists as allied to the miocene. He agreed with Prof. Rogers as to the want of a complete correspondence between the American and European tertiary, and also with regard to the absence of a close connection between the American tertiary of different epochs.

Mr. Desor also exhibited a shark's tooth from the limestone deposit at Keokuck, Iowa, on the right bank of the Mississippi. It resembled the teeth of the genus *Psammodens*. By comparing with the teeth of the Port Jackson shark, which, however, are much smaller, an inference might be drawn as to the size of the species. The Port Jackson shark being three or four feet in length, the size of this species must have been very great. There was a doubt, Mr. Desor remarked, as to the true geological position of the limestone from which this specimen was procured. The Western strata cannot be so readily referred to those of Europe, as those of the eastern parts of the United States. The distinctive traits of the strata of the East diminish on going west.

These strata mark the existence of a vast ocean, the shore of which was along the Atlantic coast. He saw, however, no reason to infer that the Western deposits were *deep-sea* deposits, as the existence of Echinoderms and fossil corals which live in water of moderate depth would indicate the contrary. He thought that many of the Eastern deposits would be reduced to one epoch, for if at the present time we suppose an elevation of the sea-shore for a few feet, there would be a succession of strata of various compositions similar to those referred to.

Prof. Rogers said that he considered the New York and Pennsylvania beds of limestone to be of littoral origin, their outlines becoming confused and blended on going west, until in the district of Cincinnati they come in contact with the overlying clay, which in the East is separated from it, making one common mid-sea deposit of limestone. This is shown by the diminishing size of the pebbles and the thinning of the layers as they recede from the East. In a similar way the paleozoic horizons become confused towards the West. The deposits which overwhelmed the animals of the East did not reach the West, and they continued to live, so that inhabitants of different strata at the East occur together at the West. Thus, where there was a layer of thick mud in the East, there is found in the West a deposit of thin clay, forming shales interposed in the limestone. The attempt, therefore, to identify the paleontological character of the deposits of different seas, is unphilosophical. Prof. Rogers also inferred, from various facts which he had observed both east and west of the Alleghanies, and which he connected with the changes consequent upon the subsidence of a sea from the Atlantic slope and from the Western valley, that a continent once occupied the place of the present Atlantic, and that North America was then a sea; and it was evident that precisely the same races did not exist, at the same time, on the east and west sides of that continent. He contended, therefore, for the renunciation of the European nomenclature and classification.

PHYSICS OF THE MISSISSIPPI RIVER.

THE *American Railroad Journal* publishes a memoir on "the physics of the Mississippi River," by C. G. Forshey, from which we extract some of his results. The mean depth of the river at high-water-mark is not materially different at Natchez from what it is at Carrollton, though nearly 300 miles apart. A section of the river at Carrollton, made at high water of 1849, is 168,226 square feet; and at Vidalia (opposite Natchez) the section is 167,000 feet. The bottom of a uniform channel 400 miles up is about on a level with the bar at the Southwest Pass. The rate of fall is not uniform on the surface, but decreases in declivity towards the Gulf, giving a curve of inclination (probably parabolic) to which the Gulf level is a tangent, at the Balize. The mean rate of inclination is 1.80 inch per mile, for the first hundred miles, 2.00 inches for the second hundred, 2.30 inches for the third, and 2.57 inches for the fourth hundred miles. The low-water curve of declivity has a mean descent of .24 inch per mile for the first hundred miles, and .50, .83, 1.20 inch for the next consecutive three

hundred miles; making the total difference of level 21.1 feet, from a point ten miles above Natchez to the Balize. As to depth, extreme depths of 188 feet have been found in some places, but, when the channel is distant from both shores, 125 feet is the usual maximum. A section made in front of Vidalia gave a mean depth of 80.5 feet, with a maximum of about 130, and a like section of high-water channel at Carrollton gave a mean depth of 71.6 feet. The low-water depth may always be obtained by subtracting the range from the high-water. At Vidalia, the range is 51 feet, and at Carrollton 15 feet. The mean depth of the low-water sections would then be 29.5 feet and 56.6 feet. And the sectional areas at low water give 133,010 square feet for Carrollton, and 108,000 at Vidalia.

The uniformity of breadth in the channel is a remarkable feature of the Mississippi River. A great number of measurements from the Balize to Galena, 1,700 miles up the river, give a mean width, including wide places in the bends, of about 1,000 yards; excluding these, 800 yards; and the upper portion of this is wider, including expanses produced by bends and islands, than 1,000 yards; but excluding them, it is the same. The addition of the four great rivers below makes no increase in the breadth of the river. The Missouri, 300 miles above its mouth, is half a mile wide. The result of observations made on drift-wood shows a mean surface velocity at high water of 2.61 miles per hour at Carrollton, and 2.60 miles per hour at Vidalia; respectively, 3.80 and 3.82 feet per second of time. The one was derived from 176 observations, and the other from 70 observations. At low water, Carrollton, 1.45 miles per hour, or 2.11 feet per second; at Vidalia, 1.54 miles per hour, or 2.25 feet per second. The mean velocity for mean water, as derived from thirty years' observation, is 2.26 miles per hour, or 2.95 feet per second.

From these and other data, Mr. Forshey deduces a mean discharge for the last thirty years of 12,250,000,000,000 cubic feet of water per minute. According to the estimate of Prof. Riddell, the cubic contents of sediments would be by these measurements 4,083,333,333 cubic feet, so that the sediment would cover twelve square miles one foot deep.

RATE OF FALL OF THE MISSOURI RIVER.

Appleton's Mechanics' Magazine, for January, contains an article on the Missouri River, apparently written by one of the engineers who had been engaged in surveying the route of the proposed railroad from St. Louis to the western line of Missouri. It is found that the descent of the Missouri River for the 219 miles between Kansas and Jefferson City is 179 feet or 9.8 inches per mile, and for the 150 miles between Jefferson City and the mouth 124 feet or 9.9 inches per mile, giving for the whole 369 miles a fall of 303 feet, which is at the rate of 9.85 inches per mile. The descent of the Mississippi is but 2.8 inches per mile. The rapidity of the current of the Missouri is judged to average from two to four miles an hour.

It is mentioned that, in Crawford County, at the head of one of the

forks of the Maramec, which is a tributary of the Missouri, there issues from the limestone strata a river whose minimum delivery is 5,685 cubic feet per minute, furnishing sufficient water-power for driving the forges, rolling-mill, furnace-blast, flour-mill, and saw-mill of the Maramec Company. The water maintains a nearly uniform temperature in summer and winter, but the quantity delivered varies greatly.

FALLS OF NIAGARA.

PROF. AGASSIZ, in the early part of his new work on Lake Superior, is led to speak of the falls of Niagara; and after saying that for ages, while the falls have been receding from Lake Ontario, there has been a layer of very hard rock at the surface, below which the softer rock has crumbled away, causing the remarkable overhanging at Table Rock and other localities, continues,—“But from the inclination of the strata this will not always be the case. A time will come when the rock below will also be hard. Then probably the falls will be nearly stationary, and may lose much of their beauty, from the wearing away of the edge rendering it an inclined plane. I do not think the waters of Lake Erie will ever fall into Lake Ontario without any intermediate cascade. The Niagara shales are so extensive, that possibly at some future time the river below the falls may be enlarged into a lake, and thus the force of the falling water diminished. But the whole process is so slow that no accurate calculations can be made.”

ORIGIN OF SOME CURIOUS SPHEROIDAL STRUCTURES IN SEDIMENTARY ROCKS.

AT the meeting of the American Association, at New Haven, Prof. B. Silliman, Jr. exhibited some curious spheroidal structures, from the rocks of the Niagara (N. Y.) group, well known to those conversant with the geology of that district. The specimens have a curiously embossed and concave appearance, with the concavities sometimes opposite to the convexities. The regularity of these impressions is such, that, by taking any one as a centre, six others may pretty generally be counted immediately around it. These appearances have been figured by Mr. Hall, and the probable cause of the phenomena has been the subject of no little speculation. Similar appearances, however, are produced at the present day by natural causes. Prof. Silliman had observed, that excavations are made by tadpoles, identical in appearance with those occurring in the old sedimentary deposits of the rocks referred to. But there are no Batrachians so old as the Niagara group, and therefore we are compelled to refer the cause of the phenomena to the agency of great numbers of small gregarious fishes, and other animals, also gregarious, which are known to have existed at that period. These views were corroborated by Prof. Agassiz.

AGE OF THE ALPS.

SIR CHARLES LYELL, in his address before the London Geological Society, after adverting to the almost conclusive evidence which now exists in favor of referring the great nummulitic limestone formations of the Alps to the eocene, or older tertiary, and not to the cretaceous system, as was formerly done, makes the following interesting remarks: — "To the English geologist, who remembers when the clays and loose sands overlying the chalk, some of them containing shells of species identical with those now living, were looked upon as very modern, and as the creations of yesterday in comparison with the rocks of the higher Alps, it may well appear a startling proposition to learn that the clay of London was in the course of accumulation as marine mud at a time when the ocean still rolled its waves over the space now occupied by some of the loftiest Alpine summits. It will follow, moreover, as a corollary from the same data, that not only the upheaval of the Alps, but all the principal internal movements, dislocations, contortions, and inversions of the strata, are subsequent to the origin of the nummulitic deposits, and had not therefore even commenced till great numbers of the eocene, vertebrate, and invertebrate animals had lived and died in succession."

SILURIAN FORMATION IN BOHEMIA.

SIR R. I. MURCHISON, at the meeting of the British Association, stated that the Silurian rocks of Bohemia, though occupying but a small basin, 25 miles across, abound in fossils which exhibit an older series of organic remains than any known in England. M. Barrande, who has examined these rocks, has obtained from them 250 species of trilobites, and this, too, after uniting many species heretofore considered distinct. Among them he has been able to distinguish sexual differences and changes in the course of growth.

THE TACONIC SYSTEM.

At the meeting of the American Association, at New Haven, Mr. T. S. Hunt, of the Canadian Geological Survey, offered a communication, the object of which was to demonstrate the great similarity which exists between the Green Mountain rocks and those of the Hudson River group. The results of the Canadian survey have shown, says Mr. Hunt, that the Green Mountain rocks are nothing else than the rocks of the Hudson River group, with the Shawangunk conglomerates in a metamorphic condition. The so-called Taconic rocks are a series of sandstones, slates, and limestones, found at the western base of the Green Mountains, and bounded on the west by the Lower Silurian rocks of New York. Although similar in lithological character to the rocks of the upper part of the Hudson River group and the Shawangunk grits, they have been regarded by Prof. Emmons as older than the Silurian formation, and breaking up through it. If these supposed Taconic rocks are really an older formation breaking

up through the Silurian rocks on the east shore of Lake Champlain, and there playing such a conspicuous part, how comes it that a few miles only to the west this formation has entirely disappeared, and the Silurian rocks rest directly upon the formation of sienitic gneiss and limestone which is so largely developed in Northern New York. The same absence is uniformly marked along the whole northern outcrop of this formation, a distance many hundred miles along the northern shore of the St. Lawrence. Again, on the east, we have an Upper Silurian formation, which is traceable from the valley of the Connecticut to the Baie des Chaleurs. Along its western base, near the Province line, we recognize no other than those talcose, micaceous, and magnesian rocks, with their associated deposits, which pass into the so-called Taconic rocks further on by a diminution of the metamorphism. If these are not the Lower Silurian rocks, it would be necessary to suppose that formation entirely absent, for even admitting a want of conformity between them and the Upper Silurian, they should in a region thus disturbed be somewhere exposed.

To accommodate the theory of the Taconic rocks, it is necessary to suppose in this section a total absence of the Taconic rocks at the western outcrop of the Lower Silurian, and as complete a deficiency of the Lower Silurian on the eastern side of the Taconic. The two great limestone formations mentioned are traced, characterized by their respective fossils, for a distance of 700 miles to the northeast, to the peninsula of Gaspé, with an unvarying breadth between the boundaries of the two of about 50 miles, constituting a feature not less remarkable geographically than geologically. While, as already remarked, we have its western border reposing directly upon the sienites and crystalline limestones, between these two great formations, both dipping southeast, we have a series which, as they go northeast, gradually lose their metamorphic character, and are recognized as the rocks of the Hudson River group. Such are the facts that lead to the conclusion, that between the crystalline rocks of the east side of Lake Champlain and the north shore of the St. Lawrence, on the one hand, and the Upper Silurian limestones at the eastern base of the Green Mountain range, on the other, there are no rocks more ancient than the Silurian.

ON THE DRIFT DEPOSITS OF THE NORTHWEST.

THE wide-spread drift deposit of the West is particularly conspicuous in the rolling prairies. Boulders are sometimes found on its surface, generally from ledges far to the north, some of them having been brought 600 miles. As they are as large at their southernmost limit as at the northern, the transporting power can have lost none of its intensity. The drift is the thickest near the Pictured Rocks, where it is 345 feet thick. At Cape Girardeau, above the junction of the Ohio and Mississippi Rivers, it is the thinnest. It extends with scarcely an interruption from the Mississippi and the Lakes to the Atlantic. From Zanesville, Ohio, to the Alleghanies, it is wanting. On the eastern slope of the first branch of these mountains it reappears, and

as far as their eastern border is made up of materials from this source. Near Lake Michigan appears a drift deposit as a bluff 12 feet thick, made up of 9 feet of sand over blue clay. This same deposit, where it occurs near Lake Erie, has been considered by geologists as a lake drift. It is important to establish its lacustrine origin from fossils contained in it. Mr. Desor has succeeded in finding in it, on Lake Michigan, eight species of fossil shells, several of them identical with those now living in the adjoining lake. In an underlying stratum were reeds (one of which was from an inch to an inch and a half in diameter, extending up into the sand), *Equiseta*, and a piece of cedar, the locality having probably been occupied by a cedar swamp. There are no trees of this species at the present time within many miles of the spot, and the nature of this deposit leads to the supposition of a depression and subsequent elevation of the country. To the south and east of Lake Michigan is a belt of flat prairie of fresh-water origin. The rolling prairies of the West, on the contrary, are of marine origin, and probably antedate the flat. A few boulders are found on the surface of the flat prairie, the presence of which might seem to be incompatible with this theory; but they may have been deposited by ice, either in the form of icebergs or ground ice. The main drift deposit over the northern parts of the United States, Mr. Desor attributes to the ocean. On Lakes Superior and Michigan the drift striæ run from northeast to southwest. One set, however, runs due north and south, and is perhaps of a more recent origin.

Mr. Desor remarked that it was interesting to observe the influence which geological causes have had in fixing the localities of cities on the Mississippi and Ohio. The terraces of the upper Mississippi are very low and exposed to inundations, so that towns can only be built upon the bluff beyond. This limits the location of towns to those bluffs near the river. On the Ohio, on the other hand, the terraces have been elevated to the height of 50, 80, or 100 feet, and the cities are built upon this alluvial foundation, having the drift behind them; on the Mississippi they are built upon the drift itself, so that the banks of the Ohio offer the most eligible situations for settlements. — *Proceedings of the Boston Society of Natural History.*

RECENT GEOLOGICAL DEPOSITS.

Mr. DESOR called the attention of the Society to the deposits of marine shells in Maine, on Lake Champlain, and the St. Lawrence, and to the question of their probable origin. These have been referred by geologists to the tertiary deposits. Recently a deposit of fresh-water shells had been found on the borders of Lake Erie, and near Rouse's Point, about fourteen miles from Lake Champlain, he had not long since discovered marine shells of the same species as those found on Lake Champlain and at Montreal, at a height of 310 feet above the sea and 210 above the lake. They were well preserved, most of them having the valves unseparated. It had been contended by some geologists that the shells found at Montreal could not be *in situ* from the great elevation of the locality; but here they were evidently so. Sim-

ilar deposits to those on Lake Champlain are found on Lake Ontario, at a level 80 feet lower. Mr. Desor has thus been led to the opinion, that the sea had once filled the St. Lawrence, Lake Ontario, and Lake Champlain, being bounded on the east by a barrier along Lake Champlain. As the deposits in these localities do not in the opinion of the geological party to which he was attached belong to the true drift, they had proposed for them the name *Lawrencian* deposits, and he hoped the term would be accepted by geologists generally.

Prof. Rogers remarked, that throughout New England, on the river courses, and on the St. Lawrence, there are found strata of thin, laminated clays and sands, which had evidently been tranquilly deposited. During a visit to the Green and White Mountains, the past summer, he had seen these layers at an elevation of 1,000 feet above the sea, following the outline of the country, and not containing marine shells. He thought it improbable that there had been the coincidence of an elevation of these strata with the mountains and ridges where they are found. He thought it more philosophical not to suppose the former existence of the sea beyond the point where marine fossils have yet been observed. As to the strata of the White and Green Mountains, they were not entirely explicable, but they may have been the result of an extensive drainage. The name offered by Mr. Desor he was very ready to receive, as applicable to a local deposit. — *Proceedings of the Boston Society of Natural History.*

ORIGIN OF THE GREEN-SAND OF NEW JERSEY.

At a Meeting of the Boston Society of Natural History in February, Prof. Rogers presented a theory to account for the origin of the green-sand of New Jersey. This sand is found under the microscope to be sharp on its edges, and not rounded, or showing any signs of attrition. It is in the form of small granules, like grains of gunpowder, of a dark olive, sometimes greenish color, from the presence of protoxide of iron. It contains silica, about fifty per cent.; protoxide of iron, twenty; alumina, seven; potash, ten; lime and water. From its physical characters, Prof. Rogers was inclined to regard it as an original deposit. Had it been of mechanical origin, it would have contained conglomerates and been mixed with other minerals, which is not the case. Neither is there any green rock known from which it could have been derived. His theory was, that at the time when the southern part of the United States was submerged, the green-sand was deposited from the Gulf Stream. The water he supposed to have been charged with soluble silicates of volcanic origin somewhere at the South, perhaps in the region of the West Indies, which were precipitated as the current reached the cooler latitudes of the North. Dr. C. T. Jackson said he agreed with Prof. Rogers in his explanation of the green-sand deposit. The process would be similar to that of the drying of French green. He suggested thermal springs as another source from which such a deposit might be derived.

TIDAL PHENOMENA.

THE following facts and deductions respecting the action of the tides are taken from the report of the lectures of Lieut. Davis before the Smithsonian Institute.* Changes are constantly going on along our coast of the utmost importance to the commerce and navigation of the country. At Sandy Hook, for example, it is well known that where there is now dry land there was in 1836 forty feet of water; and this in the main ship-channel. In 1767 there was an open ship-channel from Barnstable Bay to the ocean, and as late as the beginning of this century, in heavy storms, the sea occasionally made a breach over the same place; but the process of construction under the law of tidal action has closed up this opening entirely, and the place is now an important part of Cape Cod. Other curious instances, derived from a comparison of the recent surveys with the earliest maps of our coast, have been noticed. Monomoy Point is constantly extending to the south. Considerable numbers of harbours and inlets, particularly along Martha's Vineyard and Long Island, have been gradually closed and converted into ponds. In the course of a few years, the salt water in the ponds thus formed gradually gives place to fresh water. In some cases the bottom of these ponds is deeper than the bottom of the adjoining ocean. This fact is one of interest, since it is found that the inhabited parts of sandy deserts, such as the oases of the Desert of Sahara, present similar depressions, the bottom of the valley being, in some instances, below the present level of the sea. During the changes in the formation of these ponds, they become the home in succession of salt-water, brackish-water, and fresh-water animals, thus affording a beautiful demonstration of the geological formation of basins, such as those of London and Paris, in which the remains of successive races of animals are found in a fossil state.

Lieut. Davis has deduced from his numerous observations the law of tidal deposits, namely, that all deposits on the external coast are made by the incoming or flood tide, and that the increase of deposit is always in the line of the motion of the tidal current. Thus, if the tide moves to the north along any part of the coast, projecting points, which may serve as nuclei, are found to elongate in a north and south direction. This action is not confined to our coasts, but applies to the explanation of phenomena noticed in France and Holland. Another important deduction is, that the deposits at the mouth of the harbours and estuaries (not rivers), known by the name of bars, are formed from materials deposited by the ocean. The action of the tide is that of constant deposition. Degradation of the coast is the effect of the waves and storms of the ocean. The general action of meteorological causes is to diminish the height of continents and to transport their materials to the sea, while the action of the tide is just the reverse, and tends to keep up and preserve around the coast the materials which have been brought down in geological periods. In this way the belts

* See *Annual of Scientific Discovery*, 1850, p. 242.

of land which skirt our coast have been thrown up, and even Long Island itself has probably been formed in the same way.

OBSERVATIONS UPON THE DEPTH, CURRENTS, TEMPERATURE,
AND TRANSPARENCY OF THE OCEAN, EXTENT OF THE GULF
STREAM, ETC.

THE maximum depth of the ocean has never yet been ascertained, and never can be by the ordinary mode of sounding. Capt. Ross adopted a method of obtaining deep-sea soundings by throwing over a heavy weight to which a small line was attached. By this means he succeeded in penetrating 4,600 fathoms (about 27,000 feet), when the weight broke off without reaching the bottom. Bottom has, however, been obtained frequently at two and three thousand fathoms. Experiments show that the great valleys of the ocean run at right angles to the ranges near our coast. The basins of the southern hemisphere dip and rise alternately from the equator towards the pole, causing very unequal depths of water.

Experiments made by Capt. Wilkes indicate that light penetrates the ocean to the depth of 80 fathoms (480 feet). The depth at which objects cease to be visible to the eye is much less. A pot painted white was let down into the water and the point of invisibility marked; upon taking it out the point of visibility was marked, and the two were found to vary but a fathom or two. In water at 36° F. the pot disappeared at six fathoms; in water at 76° F., at thirty fathoms; in the Gulf Stream, at twenty-seven fathoms; just outside of it, at twenty-three fathoms.

A report made to Lieut. Maury by Lieut. J. C. Walsh, of some observations on the Gulf Stream made in the schooner Taney, contains many interesting facts. He says, — "Though we did so much less in deep soundings in the Atlantic than expected, owing to the rough weather, bad state of the vessel, and loss of so much wire in the first experiment, nevertheless, the proving the ocean to have a depth of more than 5,700 fathoms (34,200 feet, or more than six statute miles), as was satisfactorily done in this first trial, is alone of much interest and importance. This vast depth, greater than the elevation of any mountain above the surface, and the greatest depth of the ocean ever yet measured, was reached without finding bottom, in latitude 31° 59' north, longitude 58° 43' west, on November 15th, 1849. The wire broke at this length, 5,700 fathoms, at the reel, and this large portion of our supply was thus so early lost. It preserved the exact plumb line throughout the sounding; there was a steady, uniform increase of weight and tension, with no check whatever during any instant of its descent, which proves that it could not have touched the bottom before the break. It had been very carefully measured and marked, so that the fact that the *ocean here is deeper than 5,700 fathoms* can be relied upon as accurate. The time occupied in the descent of the 5,700 fathoms, at the moderate rate it was allowed to go off the reel, was one hour and a half."

The mode adopted in the deep-sea soundings is thus described: —

"The lead used was but 10 lbs. weight, with a Stellwagen cone fitted to it. Nothing else was attached to the wire, but a small instrument (weighing about 6 lbs.) invented by yourself for indicating the depth reached. I had tested this several times to considerable depths, and found its indications correct. We had on board 14,300 fathoms of wire, weighing 3,025 lbs., all of the best English steel, of five different sizes. Every part was tested to bear at least one third more than the weight which it was calculated to sustain. An extent of 7,000 fathoms of this, weighing 1,800 lbs., carefully measured and marked with small copper labels, was linked into one piece and wound upon an iron cylinder 3 feet in length and 20 inches in diameter, the largest-sized wire being wound first, so as to be uppermost in sounding. Two swivels were placed near the lead, and one at each thousand fathoms, to meet the danger of twisting off by the probable rotary motion in reeling up. The cylinder with the wire was fitted to a strong wooden frame, and machinery attached—fly-wheel and pinions—to give power in reeling up. Four men at the cranks could reel up with ease, with the whole weight of wire out. The whole apparatus could be taken apart and stowed away in pieces. It being so large and massive, this was indispensable in so small a vessel as the *Taney*. When wanted for use, the frame was put together and secured to the deck; the reel hoisted up from below and shipped in its place; a *fairleader* was secured to the taffrail, being a thick oak plank, rigged out five feet over the stern, having an iron pulley fitted in its outer end, and two sheet-iron fenders of semicircular shape, fitted under it, to guard the wire from getting a short nip in the drifting of the vessel. The wire was led aft, from the reel over the pulley, which traversed freely in the fairleader, and passed between these fenders into the water."

The investigations upon the under-currents were few in number, and none were made in the Gulf Stream, but enough was done "to warrant the conclusion that the under-currents are generally stronger, setting in various different directions, than those of the surface." The following was the mode practised for testing the under-currents. "The surface-current was first tried by the usual mode (a heavy iron bottle being lowered from a boat to the depth of 80 fathoms); then, for the trial of the under-current, a large chip-log, of the usual quadrantal form, the arc of it measuring full four feet, and heavily loaded with lead, to make it sink and keep upright, was lowered by a light but strong line, to the depth of 126 fathoms; a *barrega* was attached as a float, a log-line fastened to this *barrega*, and the rate of motion of this float, as measured by this log-line and the glass, and the direction as shown by a compass, were assumed as the velocity and set of the under-current. No allowance was made for the drag of the *barrega*, which was always in a different direction from the surface-current."

The temperature of the water at various depths was also a matter of investigation, and the following are some of the results. May 12, water at surface, 75°; at 50 fathoms, 76°; at 100 fathoms, 69°. May 13, at surface, 77.5°; 50 fathoms, 76.5°; 100 fathoms, 74.5°; 500 fathoms, 53°. May 14, surface, 77°; 1,050 fathoms, 49°. May 18, surface, 70°; 100 fathoms, 65°. In crossing the Gulf Stream, at 8

A. M., the water at surface was at 66° , air 54° ; at 9, 73° and 53° ; at 10, 76° and 55° ; at 11, 77° and 56° . Entering the Gulf Stream at $37^{\circ} 22'$ N. lat., $71^{\circ} 26'$ W. long., and leaving it in $36^{\circ} 16'$ N. lat. and $70^{\circ} 57'$ W. long., they found a breadth of 71 miles for the Gulf Stream between those points of latitude and longitude. On May 29, in $33^{\circ} 58'$ N. lat., 72° W. long., "the current was tried at the depth to which the kettle was lowered, 80 fathoms. I found it tended in the same direction as that at 126 fathoms (counter to the surface-current), but at so small a rate that it could hardly be measured; not more than one tenth of a knot per hour, the float moving at only this small rate, being but one tenth of the velocity at which it had moved just before when trying at 126 fathoms. This indicates that the kettle had just penetrated the under-current; and thus, by this means, it would appear practicable to measure the depth of the surface-current, or its point of contact with the counter under-current. In crossing the Gulf Stream a second time the water at surface at 8 A. M. was 71.8° ; at 50 fathoms, 71.8° ; at 100 do., 67° ; the air 70° . At 9 A. M., at surface, 73° ; 10 A. M., at surface, 77.5° ; 11 A. M., at surface, 78.5° ; 12 A. M., at surface, 78.5° ; 50 fathoms, 77.5° ; 100 do., 72.5° ; the air, 76° . 79° was the highest temperature found, when at the same time it was 77° at 50 fathoms, and 74° at 100 fathoms. Its velocity, as felt by us in crossing this time, was 2.5 knots per hour, setting N. 77° E. We got out of it in lat. $36^{\circ} 42'$ N., long. $72^{\circ} 10'$ W., bearing from the point of entrance N. 16° E. distant 78 miles; 78 miles, therefore, appears the breadth between these points of latitude and longitude. After leaving the Gulf Stream the water maintained an average temperature of 53° until we reached New York."

As to the extent of the Gulf Stream the writer says:—"We discovered the hot waters of the Gulf Stream extending as far east as $72^{\circ} 10'$ in a latitude so far south as $33^{\circ} 30'$. You will notice that whenever we reached that longitude in our various tracks between the latitudes of $33^{\circ} 30'$ and 34° north, we experienced a sudden change of as much as 5° and 6° in the surface temperature, 70° to 76° . This must be a branch or offset from the Gulf Stream, being so far to the eastward of the limits hitherto given to it in those latitudes. The current was found to be one knot per hour setting W. N. W., and the under-current at 126 fathoms, one knot setting to the east.

"Our measurements by the hydrometer show that in some parts, if not in most parts of the ocean, the water is specifically *lighter* at depths than at the surface, when reduced to like temperature, the correction for this difference being applied. I found on one occasion the following large difference:—On December 8, at surface, 1,028.6 (distilled water as standard, held at 1,000); at 200 fathoms, 1,028.4; at 500 fathoms, 1,027.2; all at 60° temperature. This was in latitude $31^{\circ} 42'$ north, longitude $38^{\circ} 12'$ west. The specific gravity generally found at surface appears about 1,028.4 at 60° temperature; and this specific gravity at surface appears, according to our record, more variable than that at depths. The greatest *transparency* of the water observed was seventeen fathoms, being able to see a large lead, painted white, at that depth. This was in latitude $21^{\circ} 4'$ N., longitude $66^{\circ} 36'$ W.

"The aneroid barometer was set with the *mercurial* on leaving New York in October. It commenced at once to differ, indicating higher; and, though its daily fluctuations agreed well, this difference steadily increased until, by the time we got back to New York, seven months after, it had reached as high as six tenths of an inch above it; thus acquiring an error of very nearly one tenth of an inch a month. This leads me to doubt whether this ingenious instrument can ever be sufficiently trusted to take the place of the *mercurial*, though it is so much to be desired."

ON THE CURRENTS OF THE ATLANTIC, AND THE EXISTENCE OF
THE NORTHWEST PASSAGE.

LIEUT. MAURY said, that in studying the system of oceanic circulation he had found it necessary to set out with a very obvious and simple principle, viz. that from whatever part of the ocean a current was found to run, to the same part a current of equal volume was obliged to return. Upon this principle was established the whole system of currents and counter-currents. It is not necessary to associate with oceanic currents the idea that they must of necessity, as on land, run from a higher to a lower level. So far from this being the case, some currents of the sea actually run up hill, while others run on a level. The Gulf Stream was of the first class. The bottom of this stream he had shown some years since to be an inclined plane, running upwards. If the Gulf Stream was 200 fathoms deep in the Florida Pass, and but 100 fathoms off Hatteras, it is evident that the bottom would be uplifted 100 fathoms within that distance, and that, while the bottom of the Gulf Stream was up hill, the top preserved the water level, or nearly so. The currents which run from the Atlantic into the Mediterranean, and from the Indian Ocean into the Red Sea, were the reverse of this. Here the bottom of the current was a water-level, and the top an inclined plane running down hill. The Red Sea, for example, lies for the most part in a rainless and riverless district. It may be compared to a long, narrow trough. It is about 1,000 miles long, extending nearly north and south, from lat. 12° or 13° to the parallel of 30° N. The evaporation from its surface is immense, and may be safely assumed to equal a rate of two tenths of an inch per day. Now, if we suppose the current which runs into this sea to average from mouth to head 20 miles a day, it would take the water 50 days to reach the head of it. If it lose two tenths of an inch from its surface daily by evaporation, by the time it reached the Isthmus of Suez, it would have lost 10 inches from its surface. Thus the waters of the Red Sea ought to be lower at the Isthmus of Suez than at the Straits of Babelmandel. They ought to be lower from two causes, viz. evaporation and temperature; for the temperature of that sea is necessarily lower at Suez, in latitude 30°, than at Babelmandel, in latitude 13°. To make this quite clear, suppose the channel of the Red Sea to have no water in it, and a wave ten feet high to enter the straits, and flow up this channel at the rate of 20 miles a day for 50 days, losing daily by evaporation two tenths of an inch, it is easy to

perceive that at the end of the fiftieth day it would not be so high, by 10 inches, as it was the first day it commenced to flow. The top of this sea, therefore, is probably an inclined plane. But the salt water, which has lost so much of its freshness by evaporation, becomes salter, and therefore heavier. The lighter water at the straits cannot balance the heavier, colder, and salter water at the isthmus, and therefore the heavier water must either run out as an under-current, or it must deposit its surplus salt, and thus gradually make the bottom of the Red Sea a salt bed. As we know that this latter process is not going on, we infer that there is from the Red Sea an under or outer current, as from the Mediterranean through the Straits of Gibraltar. The rivers which discharge into the Mediterranean are not sufficient to supply the waste of evaporation, and it is by this under-current that the salt carried in from the ocean is returned to it again; were it not so, the bed of that sea would be a mass of solid salt. Thus it is that by a system of compensations the equilibrium of the seas is maintained.

Lieut. Maury said that he had noticed this fact, that, inasmuch as the Gulf Stream was a bed of warm water, lying between banks of cold water, the warm water was lighter, and therefore the surface of the Gulf Stream was in the shape of a double inclined plane, like the roof of a house, down which there was a shallow surface or roof current, from the middle, towards either edge of the stream. This fact had been confirmed in a singular way; a person who had been engaged on the Coast Survey, with observations on the Gulf Stream, had noticed that, when he tried the current in a boat, he found it sometimes one way and sometimes another, but scarcely ever in the true direction; whereas the vessel, which drew more water, showed it constantly in one direction.

Lieut. Maury also called attention to this remarkable fact, — that, though there be well-known currents which bring immense volumes of water *into* the Atlantic, we know of none which carry it out again, and which, according to the principle before stated, ought to be found running back from that ocean. The La Plata, the Amazon, the Mississippi, and St. Lawrence, with many other rivers, run into this very small ocean, and it is not probable that all of these waters are taken up from it again by evaporation; “yet the sea is not full.” Where does the surplus go? The ice-bearing current, from Davis’s Straits, which is counter to the Gulf Stream, moves an immense volume of water down towards the equator. The ice-bearing current which runs from the Antarctic regions, and passes near Cape Horn into the Atlantic, and the Lagullas current which sweeps into it around the Cape of Good Hope, both move immense volumes of water, and bear it along also towards the equator. This water must get out again, or the Atlantic would be constantly rising. A part of the Gulf Stream runs around North Cape into the Arctic Ocean. The thermal charts now in process of construction, under the direction of Lieut. Maury, at the National Observatory, prove this, as also do the charts of Prof. Dove, of Berlin. But this current probably performs its circuit of the Arctic Ocean, and returns to the Atlantic with increased volume. The great rivers of Northern America, Asia, and Europe, that empty into the

Frozen Ocean, as well as the current from the Pacific into Behring's Straits, all sources of supply, serve, in the opinion of Lieut. Maury, to swell the current down from Baffin's Bay through Davis's Straits into the Atlantic.

That there was an open water communication, some times at least, from Behring's Straits to Baffin's Bay, had been all but proved by the results of investigations undertaken about ten years ago, at the National Observatory, with regard to the habits, migrations, etc., of the whale.* These investigations were conducted in such a manner as to show, by a glance at the chart, in what parts of the ocean, and in what months of the year, whales had and had not been seen. These investigations soon led to the discovery, that to the Right Whale the equator is a wall of fire; that that animal is never found near it, seldom or never within a thousand miles or more of it on either side. This fact induced Lieut. Maury to inquire of the whalers, whether the Right Whale of the northern and of the southern hemispheres was the same animal. The answer was "No." The Right Whale of the latter region, as described by these men, is a small pale animal, the largest scarcely yielding more than 50 barrels of oil. Whereas, that of the northern region is a large dark animal, yielding frequently to the single fish upwards of 200 barrels. About this time a whale ship returned from a voyage through Behring's Straits, where she also found the Right Whale of the North Pacific. This fact induced the further inquiry, as to whether the Right Whale of Behring's Straits, and the Right Whale of Davis's Straits was the same animal. For since the fact has been established that the Right Whale of the North Pacific could not cross the equator, and therefore could not get into the North Atlantic by either of the Capes, a reply in the affirmative to this inquiry would be another link in the chain of circumstantial evidence going to prove the existence of a so-called Northwest Passage. The answer from the whalers in this instance was, in effect, "We have not had an opportunity of comparing the two animals, except after long intervals, but, so far as we can judge, they are the same fish." So far as the other facts go, it would appear probable that there is, at times at least, an open water communication between the two straits; for the instincts of the whale, one might suppose, would prevent him from sounding under icebergs, neither could he pass under barriers of great depth or breadth. Seeing that water runs through Behring's Straits from the Pacific, as well as round the Capes, into the Atlantic, where, therefore, was the escape-current from the Atlantic? The trade-winds, Lieut. Maury was prepared to show, were the great evaporating winds. They were the winds which, returning from the polar regions, deprived of all the moisture which the hyperborean dew-points could compress from them, first came in contact with the surface of the earth, and consequently with an evaporating surface, when they were first felt as trades, and where, therefore, they were dry winds. Now could the vapor taken up by these winds so increase the saltness of this sea in the trade-wind

* See *Annual of Scientific Discovery*, 1850, p. 158.

region as to make the water there, though warmer, yet specifically heavier than that below, and also than that within the regions of variable winds and "constant precipitation." If so, might we not have the anomaly of a warm under-current in the South Atlantic Ocean, for that was the only place of escape for a counter-current from the Atlantic? — *Proceedings of the American Association, Charleston.*

GREAT ARTESIAN WELL OF BAVARIA.

In 1832 the boring of an artesian well was commenced near the Baths of Kissingen, in Bavaria, with a view of furnishing the salt-works of that place with a supply of saline water. From the period referred to, the work has been prosecuted at intervals until August 12, 1850, when, the auger having penetrated the earth to the great depth of 1,878½ feet, a column of salt water was forced out with such prodigious force as to elevate it 58 feet above the surface of the ground. The water, of remarkable clearness, issues from the soil with a temperature of 90° F., charged with 3½ per cent. of pure salt, at the rate of 100 cubic feet per minute. The force with which the column of water is ejected to the height stated is due in great part to a source of pure carbonic acid gas, which was met with at the depth of 1,680 feet from the surface, at the junction of strata of gypsum and sandstone. In fact, observations made during the progress of the work seem to show the existence of a stratum of carbonic acid gas, underlying the whole valley of Kissingen, and imparting to the springs in the vicinity a peculiarly piquant and pleasant character. The saline valley in which Kissingen is situated stands at an elevation of 650 feet above the level of the Baltic. The stratification of its rocks from the surface downwards, as it has been revealed by the successive borings, is extremely simple. The boring implements first went through 1,240 feet of variegated sandstone, then through 350 feet of sandstone of the Vosges formation, next through 150 feet of magnesian limestone (Zechstein), and lastly through 138½ feet of rock salt; thus reaching a total depth, as before stated, of 1,878½ feet. In the latter, or rock-salt stratum (which is presumed to be 1,000 feet thick), a pure saline source is formed by solution of the rock-salt in water. This solution has been found to hold not less than 27½ per cent. of salt, and as there is little likelihood that they would be able to penetrate into the rock beyond 30 feet deeper, to that extent the perforation is to be pushed, and the well completed by the end of this year. When the entire work shall have been completed, 3½ cubic feet of brine per minute, free from iron and all other impurities, capable of yielding 50 lbs. of crystallized salt, will be conveyed to the boiling house for crystallization, carrying with it a temperature of as much as 92° F., which it will bring up from a depth of 1,900 feet.

This well, if we except those reported to exist in China, is the deepest hitherto completed. Its whole cost, from first to last, will amount to £ 6,660, including the fixtures requisite for its present use. During the first 11 years of its progress, 800 feet only were bored through the rocks, and the work was often suspended and interrupted

In the course of the operations, two distinct salt strata were gone through, at 222 and 1240 feet depths, with the respective temperatures of 50° and 66° F., and $1\frac{1}{4}$ and $2\frac{1}{2}$ per cent. of salt.

ARTESIAN WELL AT CHARLESTON, S. C.

THE artesian well at Charleston, S. C., has attained a depth of 952 feet; the last 19 feet perforated were through a stratum of argillaceous slate, intermixed with granite boulders. This depth is not exceeded by any similar work in this country. The temperature here, as well as in other parts of the world, has been found to increase gradually as we proceed downwards. Experiments made with the self-registering thermometer, under the direction of Mr. F. S. Holmes, show the average temperature at the present depth to be at least 82 $\frac{1}{2}$ ° F. The mean temperature at the surface is 65° F. This increase is not altogether uniform with the results obtained in the artesian well near Paris. There the depth is 1,800 feet, and the mean temperature at the bottom, 83° F.; at the surface, 51° F. The bore of the well at Charleston having been found to be too small, the workmen are now engaged in enlarging it, to nearly double its former dimensions. At the meeting of the American Association in Charleston, Mr. Holmes exhibited numerous specimens of fossil Foraminifera obtained during the excavations, which far exceed in size any at present living upon our coasts. — *Editors.*

ON THE ORIGIN OF SALT AND SALT LAKES.

At a meeting of the Boston Society of Natural History, Prof. H. D. Rogers presented a communication on the origin of salt and salt lakes. He thought that there was an intimate connection between the present basins of salt water and the existing distribution of the earth's climates, — a connection which, fully established, promises to afford us, through a tracing of the distribution of the ancient saliferous deposits, much insight into the climates of the earth in the past periods. A sound geological theory teaches that the original source of the salt of the ocean, and of all the salt lakes, was in the chlorides of the volcanic minerals and rocks of the earth's crust. The action of the descending rain is to decompose these rocks, and to dissolve and float away into the receptacle of the sea the soluble salts which they contain. The geological revolutions shifting at successive times the waters of the ocean from their bed, have laid dry a portion of the sediments, leaving behind a part of the sea-water to be evaporated, thus impregnating the strata with its saline ingredients. Thus we find, that all the marine deposits, however far removed at present from any ocean, contain an appreciable quantity of sea-salt. The amount of salt in the ocean, if spread over the dry land, would form a stratum several feet thick over the whole surface.

Prof. Rogers considers, that all salt basins must have been Caspians, seas without outlets, where the dissolved salts have been stored up; all such seas are more or less saline. As the Caspian Sea is

eighty-three feet below the level of the Atlantic, it may be said of this, that it is the salt of the Atlantic, shut off in this basin by some surface change, and gradually having become very salt from concentration in a contracting basin. But this cannot explain the occurrence of salt lakes several thousand feet above the sea-level. He thinks the formation of these salt lakes depends on the laws of climatology. In those zones of the earth's surface where the evaporation is greater than the fall of rain, and in those only, we find such saline lakes. In the West of Europe, the fall of rain is greater than the evaporation; in the East the opposite is true; in the latter we find salt lakes and basins. In South America there is a prevailing wind from east to west, the moisture of which is stopped by the Andes, on whose western side, in Peru and Chili, hardly any rain falls; amid this excessive evaporation, we find salt lakes. In the southern region of South America, the prevailing wind is from west to east; its moisture is also stopped by the Andes, but by the western slope; hence, on the east, we have the arid plains of Southern Patagonia, where are also found salt lakes. The same may be noticed in California. The constant drainage of circumjacent districts has been bringing into insulated basins fresh accessions of saline matter dissolved or leached away from the strata over which they flow, while the evaporation under an arid climate, carrying off the surplus water, and preventing its flowing on into the general ocean, has been the means of accumulating in these receptacles this constantly growing supply of salt. By this equilibrium between the drainage of a region and the evaporation, the waters become at last so strongly impregnated as to deposit or crystallize the salt upon their margins. Following up the same general fact of the incessant solution of the rocks, we behold in the sea itself a basin like the other salt ones, which has no outlet for its surplus supplies but back again by evaporation into the atmosphere. Looking, then, at the primeval condition of an atmosphere of aqueous vapor just after the period when the earth's general temperature was incompatible with this state of water, it was a fresh ocean, and not a salt one.

Prof. Agassiz remarked, that the facts and views unfolded did, as the author said, furnish a new means of interpreting the ancient climates of the globe. From the fossil vegetable and animal organic remains, geologists have long felt themselves provided with sensitive indexes of the past temperatures of the earth at different periods, but never until now had they been supplied with a hygrometer. This, Prof. Rogers had furnished.

In further confirmation of these views, Dr. C. T. Jackson stated, that the water of the River Jordan was found upon evaporation to contain the same ingredients as the Dead Sea into which it flowed.

PETRIFICATION.

SERRES and FIGUIER have discussed the conditions necessary for the petrification of animal substances. They must be immersed in water containing either large quantities of lime-salts, or silicates. The

properties of the animal substances themselves are not without influence ; when of a somewhat persistent nature, they are usually petrified by means of lime-salts, while, with unstable substances, the petrification is effected chiefly with silicates. The authors are of the opinion, that the process of petrification is still in operation, and in support of this view bring forward a number of observations made on the shores of the Mediterranean. If shells are left upon the beach, they gradually undergo decomposition, but are not petrified. At a certain distance from the shore, the hollow and prominent parts of the surface are worn down, and at length disappear ; the sand collects and hardens in the cavity of the shell, smaller shells being sometimes accidentally inclosed. The calcareous mass, which, by the gradual process of substitution, is ultimately precipitated throughout the whole substance of the shell, forms a centre of attraction for all the salts held in the surrounding water, which are accordingly deposited in a crystalline state upon both the interior and exterior of the shells, forming crystalline cases of carbonate of lime often very regular in structure. Thus the lime originally existing in the shells is dislodged and replaced again. All species of shells, however, do not suffer the same transformation. The shells of the oyster and the pecten receive the petrifying solution chiefly between their lamellæ, and are thus strengthened and more closely assimilated to stone than in their natural state ; some of the shells with thin valves become coated with a species of calcareous cement, which fastens them together in the same way as is seen in primeval shells. The *Ostrea edulis* is often covered with a crystalline coating of calc-spar, which renders it as thick as those petrified in rocky masses. When the process of petrification is complete, no vestige of the original structure of the shell remains. When shells, which have been thus petrified, are in contact with water containing organic matter in a state of petrification, their surfaces very often assume a black or dark-blue tint, arising from the formation of sulphide of iron by the action of the reduced sulphates upon the sesquioxide of iron contained in the shells. In the same manner as the process of petrification is still in operation, the formation of fossiliferous sandstone also proceeds without cessation. Masses of shell, more or less petrified, lying buried in the sand of the Mediterranean, are penetrated by a clay, under the influences of which they are hardened, as if by Roman cement. Masses of metal, lying in the water, also form nuclei, around which the bases of the salts dissolved in the water are aggregated with muscle-shells, sand, and the oxide of the metal, thus forming the basis of a rocky formation. — *Jameson's Journal*.

THE DYNAMICS OF EARTHQUAKES.

IN the transactions of the Royal Irish Academy, Mr. R. Mallet publishes a treatise, "On the Dynamics of Earthquakes, being an Attempt to reduce their observed Phenomena to the known Laws of Wave Motion in Solids and Fluids." As clearly as the subject will permit, we shall endeavour to give an abstract of the general theory.

Mr. Mallet's inquiry commences with a demonstration of the cause of the rotary or vortical motion supposed to be peculiar to earthquakes; one of the most remarkable instances of this movement is that mentioned by Sir C. Lyell, where the upper stones of a square pedestal are described as having been turned round several inches from their place without falling, while the lower blocks retained their original position. An analogous case is cited by Darwin; the buttresses of the Cathedral at Concepcion were twisted, so to speak, clean off from the walls, while the walls themselves remained standing, and comparatively uninjured. Assuming the vortical theory to be the true one, the rotary force sufficient at its centre to displace such vast masses of masonry would be inconceivably great at a few hundred feet distant; so great, indeed, that nothing could resist it, and the tremendous phenomena of earthquakes would be a thousand times more terrible than they already are. Mr. Mallet in brief terms shows that the effects described can be satisfactorily accounted for on other grounds. "I assume," he observes, "nothing more than what is universally admitted, — that during earthquakes a motion of some sort takes place, by which the ground itself, and all objects resting upon it, are shaken, or moved backwards and forwards by an alternate horizontal motion, within certain limits, which, for all present evidence to the contrary, may be a straight-line motion, though possibly variable in direction at different and sometimes closely successive times, and the velocity of which is sufficient to throw down or disturb the position of bodies supported by the earth, through their own inertia." Whether a building shall be twisted round or completely overturned by the progressive motion in a straight line depends on the centre of gravity of the edifice. "The effect of the rectilinear motion in the plane of the base," we read, "will be to twist the body round upon its bed, or to move it laterally, and twist it at the same time, thus converting the rectilinear into a curvilinear motion in space." Next we have the question as to whether the motion is alternate backward and forward, by which, as some have assumed, displaced objects should be restored to their former position. But as the back stroke cannot be so powerful as the forward one, it necessarily fails to move the disturbed bodies from the situation in which the forward stroke left them. This general view is not affected by the fact of bodies being occasionally thrown down in opposite directions, — as the east and west walls of a building; such anomalies are to be explained by differences of resistance, weight, or connection, or simply by the *return* of the secondary or reflected wave.

The only conceivable alternate motion that answers to all the circumstances observed in earthquakes, is that of *an elastic compression*; in other words, a wave of elastic compression, passing along through the crust of the earth, in parallel or intersecting lines. Earthquake shocks originate either on the land, or under the ocean, the latter being the most disastrous in their consequences. "When the original impulse comes from the land, an elastic wave is propagated through the solid crust of the earth, and through the air, and transmitted from the former to the ocean water, where the wave is finally spent and

lost. When, on the other hand, the original impulse comes from the bed of the deep ocean, three sorts of waves are formed and propagated simultaneously; namely, one, or several successively, through the land, which constitute the true earthquake shock or shocks; and coincident with, and answering to every one of these, one or more waves are formed and propagated through the air, which produce the sound like the bellowing of oxen, the rolling of wagons, or of distant thunder, accompanying the shock; and a third wave is formed and propagated upon the surface of the ocean, which rolls in to land, and reaches it long after the shock or wave through the solid earth has arrived and spent itself." While the impulse is passing under the deep water of the ocean, it gives no trace of its progress at the surface, in all probability; but as it arrives in soundings, and gets into water more and more shallow, the undulation at the bottom, the crest of the earth-wave, brings along with it, — carries upon its back, as it were, — a corresponding aqueous undulation upon the surface of the water. This, which, adopting Airy's nomenclature, might be called the *forced sea-wave* of earthquakes, has no proper motion of its own: it is simply a long, low ridge of water, pushed up at the surface by the partial elevation of the bottom immediately below it, this latter elevation travelling with such immense velocity, that the hillock of water pushed up above it has not time to flow away laterally, and reassume its own level. Thus, then, the earth-wave below, when in shallow water, is attended by a small forced sea-wave, vertically over it, upon the surface of the sea, and these two reach the inclined beach or shore at the same moment; but as the beach is so inclined, and the forced sea-wave, as well as the earth-wave, are long and flat, and the velocity of the latter very great, the earth-wave, as it were, slips from under the forced sea-wave at the moment of reaching the beach, which it for the moment elevates, by a vertical height equal to its own, and as instantly lets drop again to its former level.

"Besides the surface ocean-wave, a wave of sound will also be propagated through the water, and reach the land long before the surface-wave arrives. The sound of the earth-wave, on the contrary, travels with it, and is heard on shore at the same moment that the shock is felt. It seems hard to believe in this literal wave-like motion of rigid earth and rock, yet science teaches that the intermobility of particles is not only possible, but actually takes place. The vibrations of the air of a drawing-room shake the solid walls of the house, when a tune is played upon a pianoforte, or otherwise the tune could not be heard in an adjoining house. Captain Kater found that he could not perform his experiments upon the length of the seconds pendulum anywhere in London, for the solid ground everywhere vibrated by the rolling of carriages," &c. In marshy ground resting on sandstone, the vibrations caused by the passage of a railway train have been perceived at a distance of 1,100 feet laterally, but vertically they cannot be detected through sandstone beyond 100 feet. Houses, towers, and tall chimneys rock with the wind. "Salisbury spire moves to and fro in a gale more than three inches from a plumb line." On removing the props of exhausted coal-seams, the superincumbent mass

sinks with tremendous noise and violence, often taken for an earthquake shock. "At the latter end of last century, one or more of the great vertical and impost stones of Stonehenge suddenly fell down; the concussion produced a wave, which was transmitted around in every direction, like that upon a pool of water into which a pebble has been dropped, and the shock felt in all the neighbouring hamlets was so great, that for some time, until the cause was discovered, it was thought to have been an earthquake, as in fact it was, though not produced by the usual causes. So, also, when the great powder magazine was blown up near Corunna, at the conclusion of Sir John Moore's retreat, the ground rocked sensibly for miles away, and the wave was felt at a distance before the sound of the explosion was heard."

It is generally known that an earthquake is frequently accompanied by a disturbance of the ocean, which at times does great mischief at places far from the centre of the shock; more so where the land slopes gradually to the water than where it is precipitous. "It is remarkable," says Darwin, "that while Talcahuano and Callao, both situated at the head of large shallow bays, have suffered severely during every earthquake from great waves, Valparaiso, seated close to the edge of profoundly deep water, has never been overwhelmed, though so often shaken by the severest shocks." Many readers will remember that the great earthquake at Lisbon was followed by a huge wave, which came rushing in from the sea some time afterwards, and fearfully aggravated the previous alarm and destruction. The focus of the shock was forty miles from land, and the wave was forty feet in height; it swept three thousand persons off the quay, to which they had betaken themselves to be out of the way of falling buildings. An attempt has been made to account for the effect produced, by supposing that the falling in of a vast cavity in the ocean bed far away from the coast caused a sudden recession of water on the shore; or that, the whole mass of dry land being bodily elevated by the shock, and let down again, it would appear as though the sea had retreated and come in again; or that these effects were referrible to an upheaval of the bottom of the sea. None of these views satisfy the newly advanced theory. According to Mr. Mallet, the original impulse given to the bed of the sea acts simultaneously upon the earth, the sea, and the atmosphere, originating at the same instant, and transmitting one or more waves through each. "The earth-wave moves with an immense velocity, probably not less than 10,000 feet per second, in hard stratified rock, and perhaps little short of this in the less dense strata." But while the earth-wave travels at this rate, sound moves through water at about 4,700 feet per second, so that a double sound will be heard from the sea after the land sound. Yet at times the waves of sound are absent while the others are present. In such cases it is supposed that no fracture of the earth's crust takes place, but merely a bending or flexure, which might naturally occur without the concussions that accompany actual breaking. Differences or anomalies in the times of shocks becoming audible are accounted for by the difference of strata through which they travel. The earth-wave varies in

height from an inch or less to three feet, the latter being its vertical height in great earthquakes; the length depends on elasticity of the strata. The line where one quality of strata meets another is always marked by the greatest havoc. Dolomieu states, "that in Calabria the shocks were felt most formidably, and did most mischief, at the line of junction of the deep diluvial plains with the slates and granite of the mountains, and were felt more in the former than in the hard granite of the latter. Houses were thrown down in all directions along the junction, and fewest of anywhere these were situated in the mountains. But if the case be converse, if the earth-wave pass from highly elastic rock into a mass of clay or sand (suppose it lying in a small-sized valley), and pass across this into similar elastic rock at the opposite side, all the former results will follow."

As before observed, great earthquakes originate beneath the sea; those which have their focus inland are less destructive; the shock is generally lost beneath the ocean; or, if a powerful one, it traverses the bed, and is felt in distant countries. The movement of the Lisbon shock was twenty miles in a minute, — 1,750 feet per second; its effects were felt in Scotland. "At Loch Lomond, the water, without any apparent cause, rose against its banks, and then subsided below its usual level: the greatest height of the swell was two feet four inches. In this instance it seems most probable that the amplitude of the earth-wave was so great, that the entire cavity or basin of the lake was nearly at the same instant tilted or canted up, first at one side, and then at the other, by the passage of the wave beneath it, so as to disturb the level of the contained waters by a few inches, just as one would cant up a bowl of water at one side by the hand." Many experiments have been made by scientific observers to determine the rate of motion through different materials. The velocity of wave-transit through limestone (soft lias) is 3,640 feet per second; sandstone, 5,248 feet; limestone (primary marble), 6,696 feet; limestone (hard carboniferous), 7,075 feet; and clay-slate, 12,757 feet. A glance at these figures will enable us to conceive something of the consequences that must ensue when such immense rapidity is suddenly checked or disturbed by meeting with strata of different elasticity. There is, then, no difficulty in understanding why every thing on the surface should be prostrated; that frightful chasms should open, which, in closing again, have actually bitten human beings in two. But it must be remembered that, appalling as these convulsions may be, they "do not properly constitute part of the earthquake at all; and in order to form a clear notion of earthquake mechanics, we must carefully distinguish between these, which are but *consequences of the consequences* of the earthquake, and the earthquake-wave itself, which gives rise to them all. The earth-wave shakes the country; the features of its surface are altered by the filling of valleys and levelling of eminences; a new state of things is instantly brought about as regards its drainage; and all its meteorological circumstances alter in proportion. Hence, when, in the loose narratives of earthquakes, we read of 'lakes suddenly appearing where all was dry before,' rivers and lakes 'bursting up out of the earth,' 'lightnings and clouds of smoke

or dust accompanying the shock,' we must bear in mind that these are mere accidents, contingent upon the consequences of the principal phenomenon, — the transit of the earth-wave; namely, upon the disturbance of the surface of the land *reacting* upon its drainage, and producing violent electrical disturbances by friction, by pressure, by changes of temperature, and all these again reacting upon its climate, so as often permanently to affect it."

In conclusion, Mr. Mallet defines the efficient cause of earthquake-shocks to be a "wave of elastic compression, produced either by the sudden flexure and constraint of the elastic materials forming a portion of the earth's crust, or by the sudden relief of this constraint by withdrawal of the force, or by their giving way and becoming fractured."

EARTHQUAKES IN 1850.

VERY severe shocks of earthquakes are described under the date of April 17, as being experienced in Smyrna. They appear to have been felt throughout the whole of the Archipelago, and may be traced to the furthest boundaries of Caramania.

In the proceedings of the Geological Society of London we find a notice of the occurrence of an earthquake at Brusa, in Anatolia, at 11½ P. M. on April 19, which lasted from eight to ten seconds. The oscillation seemed to proceed from south to southwest. It was followed by two other shocks during the night, and by four others at intervals up to April 21, all comparatively slight. The same shocks were felt throughout the country as far as Kiutahiyah, and at Kirmasli on Lake Apollonia there was a temporary gush of water and sand from an opening in the earth. It was noticed that the strongest shocks followed shortly after heavy hail-storms; and also that at Tehekerghé a momentary stoppage of the mineral springs accompanied the shocks.

A shock of an earthquake was felt at Cleveland, Ohio, and its vicinity, on the morning of Oct. 1. The day was clear, and the first indication of the phenomenon was a low rumbling sound, in a northwesterly direction, which increased till it seemed like heavy distant thunder. The earth then exhibited a trembling motion, after which the sound died away. The shock was sufficiently strong to throw crockery from its shelves.

A letter from Lieut. Maury, dated Dec. 6, says, — "Capt. Ballard, of the ship *Rambler*, reports that at 4 A. M., on Oct. 30, in latitude 16° 30' N., longitude 54° 30' W., he experienced the shock of an earthquake. On the same day, in latitude 23° 30' N., longitude 58° W., and at 4 hours 30 minutes A. M., or, allowing for difference of longitude, 44 minutes afterwards, Capt. Potter, in the barque *Millwood*, experienced a like shock. The ships were about 520 miles apart. Supposing them to be in the direct line in which the earthquake was travelling, its rate will appear to be one mile in about five seconds, which is only a little slower than sound (at the rate of one mile in 4.6 seconds) travels through the air. It is worthy of note that these two vessels were over and in the direction of an elevation, the existence of which my investigations of ocean currents and temperatures have in-

duced me to suspect in the bottom of the Atlantic. This supposed submarine mountain range extends in the direction of Cape St. Roque from the Capes of the Delaware and Chesapeake.

"I have also received an interesting letter from Capt. Waters, of the ship *Vespasian*, describing a remarkable 'tide-rip,' seen by him Oct. 16, latitude $8^{\circ} 30'$ N., longitude 36° W. The day was beautifully clear, with the wind southwardly, and light. He was sitting in his cabin, and heard a loud, roaring noise, 'not unlike that of a large water-fall.' He hastened on deck, and could see nothing; but, mounting up on the house, he saw with his spy-glass, at the 'distance of three miles, the surface of the water raised some three or four feet above that nearer,' and approaching at the rate of three or four miles the hour. 'When close to the vessel, it had a fine appearance; the waves were raised at least four feet above the level of that nearer, and falling over some, like the water over a dam, and breaking against the vessel's side with such force as to heave water upon our decks. We were in the strength of it from ten to fifteen minutes, and it passed on to the N. E. I could distinctly mark its course for twenty minutes after it had passed. The surface, after it had passed, resembled that on Fishing Rip, in a rough sea, and, as the surrounding water was smooth, it struck me as a most beautiful sight. We saw at a distance two others during the day, but not so large as this. I have before seen tide-rips, so called, but none ever to compare to this, either in size or beauty.'

"In the various abstract logs returned to this office by mariners who use the 'wind and current charts,' frequent mention is made of 'tide-rips' in this region. But this evidently could not have been a 'tide-rip' caused by a current, for the ship experienced no current, and had it been a 'tide-rip,'—as the agitation of the water by currents at sea is called,—it would have lasted longer. The position of this vessel was northward and eastward of the supposed range of submarine mountains. This 'tide-rip' came from the southward and westward, the direction in which they were, and passed off to the N. E.,—that is, perpendicular to the line of their axis. Might not this extraordinary 'tide-rip' have been caused by the throes of a submarine volcano? I ask the question for the purpose of calling the attention of mariners more particularly to the 'tide-rips' so often seen in the equatorial regions."

ERUPTION OF VESUVIUS.

THE *Tempo* of Naples states that a fine eruption of Vesuvius commenced on Feb. 7, and lasted five or six days. The lava found its way down the mountain on the side away from Naples, dividing into three branches. The cone which had been gradually elevated by previous eruptions disappeared entirely. The *Riforma* states that, although the lava flowed in the direction where there were the fewest houses, it yet destroyed fifty-four houses, a villa, and a church. It is calculated that it moved over the plain at the foot of the mountain at the rate of 360 Neapolitan feet per hour. A correspondent of the *New*

York Courier and Enquirer says, — “A new crater has been formed, and the emission of lava was so immense, that it has extended a distance of seven miles, by one and a half to three miles wide, and about thirty feet deep. After descending the mountain, it has gone forward one and a half miles wide, and thirty feet deep, for a distance of five miles at least, and forms an embankment like that of a railroad raised over a plain.”

VOLCANIC PHENOMENA OF CENTRAL AMERICA.

MR. E. G. SQUIER, late Chargé to Nicaragua, delivered a lecture before the American Association, at New Haven, on the “volcanic phenomena of Central America, and the geographical and topographical features of Nicaragua.” After noticing some of the volcanoes of that region, he says, — “It seems to me that most of the volcanoes of Central America have been formed by long continued deposits. In fact, I have been a personal witness of the origin of a new volcano, which, if it does not meet a premature extinguishment, bids fair to add another high cone to those which now strew the great plain of Leon. This plain, the finest I have ever seen, lies between Lake Monagua (which has its outlet through Lake Nicaragua and the River San Juan into the Atlantic) and the Pacific. It is traversed by a succession of volcanic cones, from the gigantic Momotombo, standing boldly out into the lake, to the memorable Cosequina, projecting its base not less boldly into the ocean. Fourteen distinct volcanoes occur within one hundred miles, on this line. They do not form a continuous range, but stand singly, the plain between them generally pursuing its original level. They have not been ‘thrust up,’ as the volcano of Jorullo seems to have been, elevating the strata around them; although it is not certain but the original volcanic force, being general in its action, raised up the whole plain to its present level. All these are surmounted by beds of lava, extending in some cases for leagues in every direction. The lava-current in places seems to have spread out in sheets, flowing elsewhere, however, in high and serpentine ridges resembling cyclopean walls, often capriciously inclosing spaces of arable ground in which vegetation is luxuriant. Hot springs and openings in the ground emitting hot air, smoke, and steam, called *infernales*, are common around the bases of these volcanoes. For large spaces the whole ground seems resting upon a boiling caldron, and is incrustated with mineral deposits. Around some of these volcanoes, that is to say, those having visible craters, are many smaller cones, of great regularity, composed of ashes, volcanic sand, and triturated stones resembling septaria. They seldom support any thing but a few dwarf trees, and are covered with coarse grass. On the 11th and 12th days of April last, rumbling sounds, resembling thunder, were heard in the city of Leon, situated in the centre of the plain I have described. They seemed to proceed from the direction of the volcanoes, and were supposed to come from the great one of Momotombo, which often emits noises, and shows other symptoms of activity, beside sending out smoke. This volcano, however, on this occasion,

exhibited no unusual indications. The sounds increased in loudness and frequency on the night of the 12th, and occasional tremors of the earth were felt as far as Leon, which near the mountains were quite violent, terrifying the inhabitants. Early on the morning of Sunday, the 13th, an orifice opened near the base of the long-extinguished volcanoes of Las Pilas, about twenty miles distant from Leon. The throes of the earth at the time of the outburst were very severe in the vicinity, resembling, from the accounts of the natives, a series of concussions. The precise point where the opening was made might be said to be in the plain; it was, however, somewhat elevated by the lava which had ages before flowed down from the volcano, and it was through this bed of lava that the eruption took place. No people reside within some miles of the spot, consequently I am not well informed concerning the earlier phenomena exhibited by the new volcano. It seems, however, that the outburst was attended by much flame, and that at first quantities of melted matter were ejected irregularly in every direction. Indeed, this was clearly the case, as was shown upon my visit to the spot some days thereafter. For a wide distance around were scattered large flakes resembling freshly cast iron. This regular discharge continued only for a few hours, and was followed by a current of lava, which flowed down the slope of the land toward the west, in the form of a high ridge, rising above the tops of the trees and bearing down every thing which opposed its progress. While this flow continued, which it did for the remainder of the day, the earth was quiet, excepting only a very slight tremor, which was not felt beyond a few miles. Upon the 14th, however, the lava stopped flowing, and an entirely new mode of action followed. A series of eruptions commenced, each lasting about three minutes, succeeded by a pause of equal duration. Each eruption was accompanied by concussions of the earth, too slight, however, to be felt at Leon, attended also by an outburst of flame a hundred feet or more in height; showers of red-hot stones were also ejected with each eruption to the height of several hundred feet. Most of these fell back into the mouth or crater, the rest falling outward and gradually building up a cone around it. These explosions continued uninterruptedly for seven days, and could be accurately observed from Leon in the night. Upon the morning of the 22d, accompanied by Dr. Livingston, I set out to visit the spot. We rode with difficulty over beds of lava, until within about a mile and a half of the place, proceeding thence on foot. In order to obtain a full view of the youthful volcano, we ascended a high naked ridge entirely overlooking it. From this point it presented the appearance of an immense kettle, upturned, with a hole knocked in the bottom, forming the crater. From this, upon one side ran off the lava-stream, yet fervent with heat, and sending off its tremendous radiations. The eruptions had ceased that morning, but a volume of smoke was still emitted, which the strong northeast wind swept down in a trailing current along the tree-tops. The cone was patched over with yellow, the crystallized sulphur from the hot vapor passing up among the loose stones. The trees all around were stripped of their limbs, leaves, and bark." They attempted to ascend the cone, but

were prevented by a shower of stones, after which the eruptions ceased, and "from that period until I left Central America, I am not aware that there occurred more than one eruption, and that on the occasion of the falling of the first considerable shower of rain, on, I think, the 27th of May last. The discharges from this vent, consisting wholly of stones, may have been and probably were peculiar, for the volcanoes themselves and the cones surrounding them seem generally to have been made up of such stones interspersed through large quantities of ashes and scoriaceous sand, alternating with beds of lava.

"Much might be said on the phenomena of earthquakes as they occur in this country. The shocks seem to be of two classes, the perpendicular, which are felt only in the vicinity of volcanoes, and the horizontal, which reach over wide tracts of country. The latter are very unequal; in some places being violent, and in others, nearer their assumed source, comparatively slight. The undulating movement seems to be only a modification of the horizontal or vibratory. Sometimes these motions are all combined, or rather succeed each other with great rapidity. Such was the case with the earthquake of October last, which I experienced, and of which I can speak more authoritatively.

"There are many striking features in the topography of Central America, which seem entirely due to volcanic agency. Those which have more particularly attracted my attention are what are popularly denominated extinct craters, now partially filled with water, forming lakes without outlets or apparent sources of supply save the rains. Some of these occur on the mountain and hill ranges, and are surrounded by evidences of having been volcanic vents. But this is not always the case. I will take what is called the Lake of Masaga as an instance. This is not less than ten or twelve miles in circumference, and is not far from 1,000 feet, perhaps more, below the general level of the country. The sides are sheer precipices of trachytic rocks, splintered and blistered, and exhibiting every indication of having been exposed to intense heat. Yet if these were true craters, where are the lava, ashes, and other materials which they have ejected? There are certainly none in their vicinity which have emanated from them,—no traces of lava-streams surrounding them, nor are their edges elevated above the general level. Upon one side of the particular one which I have mentioned rises the extinct volcano of Masaga, with its proper crater, whence have flowed vast quantities of lava, part of which, falling near the precipitous walls of the lake, have quite filled it upon that side. Some of the lakes are more or less impregnated with saline materials, but others are perfectly fresh and abound in fish. The burned and blistered walls indicate, it appears to me, that they have not been caused by subsidence or the falling in of the earth or rock strata. The great plain of Leon at its highest part is elevated something less than 260 feet above the sea; yet in the vicinity of the range of volcanoes which traverse it, beds of lava, 15 feet thick, have been found in digging wells at the depth of 75 feet Spanish bars, or about 210 feet, and this at a point not the highest of the

plains, but, according to my calculations, only 130 feet above the ocean. Unless there is some great error in these data, and I can conceive of none, they would seem to prove that there has been a subsidence of the plain since the almost infinitely remote period when the bed of lava flowed upwards from the depths of the earth. I may mention that in the vicinity of the volcanoes water is scarce, and can only be obtained by digging to great depths. The particular well which I refer to, at a cattle estate eighteen miles northeast of Leon, is upward of 300 feet in depth, the water pure, with no saline materials in solution."

Mr. Squier then goes on to examine the question of a ship-canal, which he considers practicable, and, in conclusion, states that a large bed of semi-bituminous coal, resembling the Mt. Savage coal, has been discovered in San Salvador, on the banks of the River Lempa, about sixty miles from the Gulf of Fonseca.

THE LUNAR SURFACE AND ITS RELATION TO THAT OF THE EARTH.

Mr. NASMYTH read to the British Association, at Edinburgh, a paper on the above subject, which was illustrated by a series of drawings executed by the aid of a powerful telescope. After calling attention to the vast number and magnitude of crater-formed mountains, with which every portion of the moon's surface appears to be covered, Mr. N. proceeded to give the reasons for the conclusion that they are really the craters of extinct lunar volcanoes, pointing out the frequent recurrence of the central cone, the result of the last eruptive efforts of an expiring volcano. The cause of the vast number of the lunar volcanoes was traced to the rapid consolidation and contraction of the crust of the moon, whose mass, being but one 64th of that of the earth, while its surface is one 16th, has a radiating surface four times greater than that of the earth in relation to its bulk. In consequence, by the rapid cooling and collapse of the crust of the moon on its molten interior, the fluid matter under the solid crust was forced to find an escape through it, and come forth in those vast actions which have produced such numbers of volcanoes. The cause of the vast magnitude of the lunar craters was also assigned to the rapid and energetic collapse of the moon's crust, the action as regards the wide dispersion of the ejected matter being enhanced by its lightness, which is caused by the much less force of gravity on the lunar than on the terrestrial surface, so that the collapse action had to operate on material probably not half the weight of cork, bulk for bulk. The vast ranges of mountains on the moon's surface Mr. Nasmyth explains by the continued progress of the collapse action of the solid crust, crushing down or following the molten interior, which, by the gradual dispersion of its heat, would retreat from contact with the interior of the solid crust, and permit it to crush down, and so force that portion of the original surface out of the way, and in consequence assume the form and arrangement of mountain ranges. In illustration of this action, Mr. Nasmyth adduced the familiar case of the wrinkling of the surface of an apple.

The mountain ranges he considers to be nothing more nor less than the material which in the original expanded globes formed the comparatively level crust of the moon and earth. The fall of the unsupported crust on the retreating nucleus was described as yielding a very probable explanation of the appearance of granitic and igneous centres of certain mountain ranges, as well as the injection of igneous rocks in the form of trap-dikes and basaltic formations, which appear to have come forth in this manner from below the crust of the earth. The origin of the bright lines radiating from certain volcanic centres on the moon's surface was alluded to, and illustrated by the experiment of causing the surface of a glass globe filled with water to collapse on the fluid interior by rapidly contracting the surface while the water had no means of escape. The result was the splitting or cracking up of the surface in a multitude of radiating cracks, very much resembling those on the moon. This subject was further illustrated by reference to the manner in which the surface of a frozen pond may be made to crack from pressure underneath, yielding radiating cracks from the centre of convergence, where the chief discharge of water will take place, while simultaneously all along the lines of radiating cracks the water will make its appearance, thus explaining how it is that the molten material came forth from the moon simultaneously through the course of cracks, and appeared on the surface as basaltic overflow, irrespective of surface inequalities.

FALLING OF METEORITES OVER A LIMITED ZONE, OR AREA OF THE EARTH'S SURFACE.

FROM the numerous discoveries of these bodies in the States of North and South Carolina and Tennessee, within the last few years, and from the many accounts of meteoric explosions (as yet unattended by the finding of precipitated matter) over the same region, it occurred to me that there might be a concentration in the deposition of such bodies, not only on this continent, but possibly elsewhere. This idea led me to jot down upon a map of the world the authentic falls of meteorites, which have occurred since the commencement of this century, as the best mode of bringing the conjecture to a test. The result of this investigation seems to establish the existence of such a zone or region, over which meteoric falls are more frequent than elsewhere. The facts collated are these. Out of fourteen depositions of meteoric matter on the American continent during the period above referred to, thirteen, or 92.8 per cent., have taken place between the parallels of 33° and 44° N. lat., while the remaining, or one fourteenth, occurred at Macao, in the province of the Rio Grande del Norte, in Brazil. Here, then, is presented a distribution at once exceedingly unequal. Their deposition forms an imperfect stream, whose extreme length is 11° of latitude, and in longitude is about 25°. The line of most frequent deposit cuts obliquely across the 37th parallel of latitude, and manifests a partial tendency of conformation to the line of the Atlantic coast.

To show that this area has actually been the scene of most frequent

meteoric visitations within this period, and that the inference here made is not founded upon the fallacy, that contiguous regions have been as often struck by the fragments of meteors, without, however, having been reported to science, it is only necessary to observe, that the actual falls have been cited to us from districts often the most sparsely settled, while the more thickly settled States afford us no examples of meteors whatever. For instance, South Carolina has two falls; North Carolina two; Tennessee two; Georgia, Missouri, Iowa, Virginia, Maryland, each one; while Pennsylvania, New Jersey, New York, Massachusetts, Vermont, New Hampshire, and the entire British Provinces, furnish not a single example. Turning now to the Eastern world, where the surface is rather more than treble that of the American continent, we have for the same period fifty-five falls, or rather more than four times the American number, which agrees pretty nearly with what we should anticipate, after making due allowance for the more thickly settled state of its occupation, it being just, perhaps, to leave the unexplored regions of the Old and New World to balance each other. Of these fifty-five falls, fifty, or 90.9 per cent. have taken place over the comparatively narrow area comprehended between 41° and 56° N. lat.; and all but five, that is, 45 of them, between parallels 43 and 54, a zone of the same breadth as that found to be the American region for similar falls. Of the remaining five (i. e. between 50 and 55°), three fell in Northern India, one in Finland, in latitude 60° , and the fifth at the Cape of Good Hope, in latitude $35^{\circ} 5'$. The longitudinal extent of the meteoric region is here much greater than on the opposite side of the Atlantic. It extends from the sea-coast on the west, inland, and obliquely northward, for upwards of 60° ; the greatest number of falls, however, being spread over the first 30° of longitude, and the greatest concentration occurring between the parallels of 46 and 47 of latitude. But it may be necessary to defend this distribution of meteor falls also from the suspicion of the error which might arise from a defective reporting of facts, owing to supposed sparseness of population, and want of intelligence, over regions where no meteoric deposits are cited. On this point, suffice it to say, that while in the North of Spain, in every portion of France, in Sardinia, Lombardy, Bavaria, Bohemia, Silesia, they are most abundant, they are almost wholly wanting in Portugal, Central and Southern Spain, Southern Italy, Sicily, and Hungary, as well as in Denmark, Sweden, Norway, and Northern Russia.

Additional evidence bearing on this point is afforded by the localities of the meteoric iron masses, whose time of fall is wholly beyond our knowledge, their chemical composition being such as to impart to them so high a degree of persistence, that they may in particular instances be as old as any of the solid portions of the earth's surface. The Old World has presented us with fourteen localities of these masses, eleven of which are situated within the meteoric zone, and mostly between the parallels of 46 and 52° N. lat. The New World has already thirty-two such discoveries, whereof twenty-two are comprised within its meteoric region, and the most of them are found near the latitude parallel of 36° . Nor can we fail to notice another

curious fact connected with the inverted proportions, as regards the number of meteoric falls of recent date, and of irons whose time of fall is unknown, for the two continents. The European has, for a given period of time, more than four times the number of the former, and less than half that of the latter. What do we recognize here, but a fresh proof of the erroneous use of the word *new*, if understood in a geological sense, as applied to our portion of the earth? The medals we are now examining add their testimony to the abundant evidence already possessed by the geologist, that, after all, we are the true denizens of the Old World. To the question which very naturally presents itself in this place, Do these zones upon the opposite sides of the Atlantic connect by a watery region, subject to similar deposits from the atmosphere? we are wholly without evidence.

If, then, it appears that these aerial strangers alight upon our earth in such great preponderance over limited areas, can we help admitting that there presides over their descent some great law, or, in other words, that these falls take place in accordance with some fixed plan. The present stage of our knowledge may, indeed, be inadequate to develop what that plan actually is; but when we see so marked an approach by the courses of our meteoric regions to the isothermal parallels for the same zones, and, again, an observable coincidence between the trends of the meteoric regions and the isodynamic lines, we are strongly tempted to refer the forces of greatest activity concerned in the phenomenon to a union of thermal and magnetic action, although it is at the same time possible, that more powerful local attractions in the surfaces concerned, than exist elsewhere, may also exert some influences over the deposition of these singular bodies.

— *Prof. C. U. Shepard to the American Association, at Charleston.*

NEW AMERICAN METEORITES.

SEVERAL new American meteorites have within the past year been noticed and described by Prof. C. U. Shepard. The first fell during a severe thunderstorm, in the summer of 1846, about 20 miles east of Columbia, S. C. A negro saw it fall, and carried it to his mistress, saying that he had found "a lump of solid thunder." It differs from all other meteoric stones yet observed, in figure as well as in composition. It is nearly round and almost perfectly smooth, having only very slight elevations and depressions over its surface. Its diameter is about $2\frac{1}{2}$ inches, and its weight $6\frac{1}{2}$ ounces.

Its composition is as follows:—

Silica	80.420
Alumina	15.680
Protoxide of Iron	2.513
Magnesia	0.700
Lime	0.500
	<hr/> 99.813

Sp. Gr. = 2.32. From this analysis, says Prof. S., it is apparent that this stone, though coming within my trachytic order, stands at a

wide remove from any meteoric substance heretofore described, and it is probable that the compound of which this stone is principally composed constitutes a mineral species hitherto unknown.

The second meteoric mass described is the celebrated stone of Cabarras Co., N. Carolina, which fell on the 31st day of October, 1849.* The present weight of this specimen is $18\frac{1}{2}$ pounds. Its general figure is pyramidal. In color it is of a dark bluish-gray, stained with fine rust points. It is strongly magnetic, and remarkably compact, requiring repeated strong blows of a hammer to detach a single fragment. Its sp. gr. varies from 3.60 to 3.66. It is the first example belonging to the trappean order of stones, which has been described in the United States, and approximates most closely to the rare stone of Tabor, Bohemia, which fell July, 1753. An additional interest attaches to this stone, since its fall was succeeded by other meteoric displays, in the same region, of a very brilliant and striking character.

The third meteorite described was discovered by Dr. Thomas Wells, near Ruff's Mountain, Newberry, S. C. The time of its fall is not known. The figure of this mass is irregular and ovoidal, being truncate at both extremities. Its greatest length is $31\frac{1}{2}$ inches, breadth $29\frac{3}{4}$ inches, and weight 117 pounds. It is composed of 96 per cent. of iron, and 3.121 per cent. of nickel, with traces of chromium, sulphur, cobalt, and magnesium. It belongs to the class of crystalline homogeneous, alloyed, malleable irons, and resembles the meteoric iron of Texas. — *Prof. C. U. Shepard to the American Association, at Charleston.*

VALUE OF SANDSTONES AS BUILDING MATERIALS.

MR. F. A. ALGER has read before the Boston Society of Natural History a paper on the comparative value of the sandstones of New Jersey, New Brunswick, and Connecticut, as building materials. The first specimen examined was from the Bay of Fundy; it is a brownish-red variety, of a fine gritty texture, and of uniform color; it contains no scales of mica, and its specific gravity is 2.48. The coloring matter, peroxide of iron, exists only in the cement by which the particles of quartz are held together, for the pulverized stone, on being exposed to the action of hydrochloric acid, remains a colorless and nearly transparent sand. The stone contains no carbonate of lime or sulphuret of iron, either of which would essentially injure it as a building material. A mass exposed to a dry temperature of 75° to 80° for several days absorbed, when immersed in pure rain water, 3.8 per cent. of water, and would take up no more. The mass appeared very compact and free from seams, and showed no greater tendency to crumble after being immersed and heated than before. In hardness and tenacity it is greatly inferior to marble and granite, though there are some inferior kinds of granite in use which will hardly resist a greater crushing force. A cubic foot of this freestone, calculating from its specific gravity, weighs 155 pounds.

* See *Annual of Scientific Discovery*, 1850, p. 275.

The sample from New Jersey is a grayish-white sandstone, two or three shades lighter than the above. It is less uniform in its general appearance, but is about the same in hardness and frangibility. It contains a few minute spangles of mica, but no carbonate of lime or sulphuret of iron, though under the microscope there are seen a few dark spots, apparently arising from the decomposition of the latter. The specific gravity is 2.37. A mass exposed under the same circumstances as that from New Brunswick absorbed 5.8 per cent. of pure rain-water. Its absorption was more rapid and attended with a hissing sound, as if hot-air bubbles were escaping from the pores of the stone. As it takes up water more readily, it will probably part with it sooner than the first sample, thus being more liable to crumble from sudden expansion and contraction, caused by changes of temperature in the atmosphere. The weight of a cubic foot, estimated as before, is 149 pounds.

The Connecticut specimen is of a darker shade than the first, and of a coarser texture, not at all uniform, some parts being fine and granular, while others are formed of nodules of flint or quartz. It contains more oxide of iron than the first specimen, and is largely impregnated with mica and carbonate of lime, less frequently with felspar and sulphuret of iron. The lime may have an injurious effect in two ways. By the escape of its carbonic acid gas in case of fire, the walls of a building constructed of this stone would speedily crumble, or the same effect might be more slowly produced by the decomposition of its pyrites, and the formation of sulphuric acid, which would seize the lime. Its specific gravity is 2.51. Exposed as before, it absorbed 2.3 per cent. of water. This less susceptibility to absorb water is owing to the numerous quartz pebbles contained in the stone. Some samples contain 15 per cent. of peroxide of iron, which gives additional hardness to the stone. A cubic foot weighs 156 pounds.

All these sandstones belong to the sedimentary group of rocks, known as new red and old red sandstone. They are similar to the sandstone grits or carboniferous sandstones of Scotland, and of Yorkshire and Derbyshire in England, of which buildings erected as long ago as 1142 are composed, and whose ornamental portions even are said to be still in a perfect condition. The same quarry produces stone of very different qualities and colors, so that some of the Scotch buildings erected within the present century are already beginning to crumble. The sandstones of Great Britain generally contain carbonate of lime and mica, and, excepting that they are of a lighter color, have the same lithological character as those of America. It is evident that great care should be exercised in the selection of sandstone for building material. That which is good will resist fire better than marble, or granite, or even brick, for the reason that it is a fire-proof material. In our climate the prolific cause of decay arises from the expansion and contraction of the stone, by the gain or loss of water, which may be prevented to some extent by painting. In all cases the blocks of stone should be placed in the building with their planes of stratification horizontal, conformably to their geological position in their native beds, otherwise the layers will be thrown off

by the frost or other expansive force. The same caution should be observed with micaceous or gneissoidal granites.

The general conclusion arrived at is, that the first two specimens possess nearly the same character of cohesion and hardness, but the less susceptibility of the New Brunswick specimen to absorb water is certainly in its favor, more than counterbalancing the injurious effect of the iron. The absence of mica is also in its favor, while the absence of carbonate of lime in both give them a decided superiority over the foreign article. Trinity Church in New York, and the Athenæum in Boston, are built of the New Jersey stone. The Connecticut variety is probably of less value than either of the others.

Mr. Alger directs attention to the experiment recommended by Dr. Ure, for testing the durability of sandstone, which, it is said, has proved very successful in Great Britain, though its application in this country may not be followed by the same results, owing to the greater severity of our climate. It consists in immersing a portion of the stone in a saturated solution of sulphate of soda, and if then exposed to the air for some days, crystallization will take place within the stone, and cause the same disintegration that would follow from the influence of frost.

DURABILITY OF STONE.

PROF. WALTER R. JOHNSON of Washington, D. C., communicates to *Silliman's Journal* for Jan., 1851, an article on the comparative strength and durability of various American and foreign building stones, with a special reference to the durability and nature of the stone used in the construction of the Washington Monument, at Washington. At a meeting of the American Association, in 1849, Prof. Johnson presented a communication in regard to the unfitness of the material used in the construction of the monument referred to.* The facts then stated by Prof. Johnson having been repeatedly called in question, the following abstract of the article in *Silliman's Journal* will, we think, have a tendency to settle the disputed points.—
Editors.

Those rocks which, amid decomposing influences, whether derived from currents of water, meteoric agencies, or vegetable growth and decay, have been able to sustain themselves in high, naked, and angular cliffs, unprotected by soil, and yet unfurrowed by irregular disintegration, are manifestly those to which the engineer and architect are to direct their attention, when they seek materials for durable works of art. On the other hand, they will shun those rocks which the causes above enumerated have kept constantly down to a level with the ground, or which barely rise in some few patches to the surface, and are then seen disintegrating, scaling away, and covering themselves with a soil derived from their own debris. The stone used in the construction of the Washington Monument is generally known as the alum limestone, and is quarried about 13 miles from Baltimore.

* See *Annual of Scientific Discovery*, 1850, p. 275.

It is of a somewhat coarse and highly crystalline structure, and abounds in iron pyrites, qualities which, according to all practical experience, are not at all recommendatory. In examining this limestone at the quarry, Prof. Johnson found that it was worked wholly below the original surface of the ground. At a few points along the outcropping edge of the bed, the harder parts of the rock come to the surface of the ground, or rise occasionally two feet above it, covered in places with loose granules of the same rock. In some parts it is eroded into sloping channels, lined with skeletons of crystals and their slightly cohering nuclei. On removing the soil the rock is found with alternating peaks and cavities; its surfaces are more or less deeply tinged with the oxide of iron derived from decomposed iron pyrites, many veins of which traverse it in various directions. Skeleton crystals, with slightly cohering nuclei, are even more numerous than at the points where the rock crops out at the surface. Adjoining this quarry is another, of similar limestone, but of a finer grain and stronger texture. Of the unfitness even of this latter limestone, which is superior to the alum limestone, for architectural purposes, the Washington Monument at Baltimore is an instance. This Prof. Johnson finds, after a lapse of 21 years from its completion, to be in a state of rapid decay. Fractures extend throughout nearly the whole of the shaft, and in one instance a block has split into three pieces. Some of the fractures extend through 10 or 12 courses of stone, and ascend some forty or fifty feet. These dilapidations have been produced by natural causes.

When an attempt is made to polish a portion of the alum limestone, portions will occasionally be detected, which, from their softness, render fruitless all attempts to impart lustre to them. Some are so soft as to be readily scratched with the finger-nail. In many parts, little triangular cavities, from which, it appears, the last remnants of solid angles of crystals have dropped out in the operations of cutting and polishing, will easily be discovered by the eye, and slight lines forming the boundaries of large crystals are not unfrequently traceable, when the piece is brought into a strong light. A block thus polished will have all its crystals of pyrites, from their superior hardness, left slightly elevated above the surface of the carbonate of lime, which is worn away in polishing. The surface of the polished stone, thus variously marked with elevations and cavities, may be used like an engraver's plate, and will give an impression of its own markings of much interest. The following results were obtained by Dr. C. G. Page, in some experiments made to ascertain the capability of the alum limestone, and various other well-known building materials, to resist a crushing force. The experiments were made on two-inch cubes, with a powerful hydraulic press, so arranged as to indicate accurately the amount of pressure. It was found that the average strength per square inch of fine-grained Maryland marble was 4,481 (the figures representing the weight in pounds to a square inch necessary to crush a two-inch cube of the material); East Chester marble (N. Y.), the material of which the General Post-Office is constructed, 3,993; Italian marble, 3,156; Patapsco granite, 2,767; Seneca sand-

stone, the material of which the Smithsonian Institution is constructed, 2,691; *alum limestone*, 2,334; Stockbridge marble, 2,251; Aquia Creek sandstone, the worthless material of which the Patent-Office is constructed, 1,660; common brick, 1,000. In three trials of the alum limestone made by Dr. Page, an average strength of only 1,521 pounds was obtained, while the mean of four trials of Aquia Creek sandstone gave an average strength of 1,600 pounds, thus showing the inferiority of at least some portions of the material used in the Washington Monument to the Aquia Creek sandstone, which is acknowledged to be among the worst building materials to be found in the country. Prof. Johnson also gives a large number of tables showing the comparative strength of many of the ordinary building materials in this country and Europe, in comparison with all of which the alum limestone is greatly inferior. A 1.5 inch cube of Quincy sienite, the stone of which Bunker Hill Monument is built, sustained a crushing force of 15,929 lbs. per square inch; the average of two trials by Dr. Page on 2-inch cubes of alum limestone, gave a resisting force per square inch of only 2,334 lbs. The following table shows the relative value of several kinds of stone, as determined by their power to resist crushing, the value of the alum limestone being assumed as 100.

Porphyry,	1,266	Chester (N. Y.) marble,	171
Swedish basalt,	1,165	Bagneaux stone (Pantheon,	
Auvergne basalt,	703	Paris),	149
Quincy sienite,	682	Temple of Pæstum stone,	130
Oriental rose granite,	536	Patapsco granite,	118
Blue granite of Aberdeen,		Seneca sandstone (Smithsonian Institute),	115
Scotland,	468	Alum limestone,	100
White-veined Italian marble,	414	Stockbridge marble,	96
Purbeck stone, England,	392	Aquia Creek (Patent-Office) sandstone,	71
Baltimore granite,	267		
Travertine of Ancient Rome,	183		

It is but fair to state, that the alum limestone is used as the external casing only of the Washington Monument, a more durable stone having been chosen for the interior.

ANCHOR-ICE.

WATER sometimes freezes upon stones below the unfrozen surface of the water; fastened in this way, it passes under the common name of *anchor-ice*. As soon as the ice is detached, it rises to the surface and floats upon it. In explaining this phenomenon, it has been said, that, in thus freezing, the water parts with its latent caloric to the stone and crystallizes upon it, and that its crystals are then *heavier* than water. The first part of this solution is only a statement of the fact in chemical language, and the last part is opposed by the fact that the detached ice uniformly and directly rises to the surface. The observed facts are the following. Anchor-ice forms in still or running water, and often where the current is rapid, on stones, and on wood, fresh or old, under water, in masses from less than an inch to two or

three inches thick; it is of a spongy or fibrous appearance under the water, but composed of flat irregular crystalline planes or tables, with regular angles and terminations, cohering or strung along upon each other, and exceedingly white and beautiful. When the surface of the water is free from ice, and its temperature at the freezing point, that of the air being several degrees below the freezing point; if under these circumstances, there is none on the stones at sunset, they are covered in the morning, after a clear cool night. This ice begins to leave the stones in the morning, and before noon has all risen and disappeared, often covering the whole surface for some time. The depth of the ice below the surface of the water, as observed, was from a few inches to three feet.

The principle of this phenomenon is probably as follows. Saturated solutions of some salts, as sulphate of soda, at a high temperature, may be cooled gradually at rest without depositing the salt. The agitation of the cooled solution, on putting in a rod of glass, wood, or metal, commonly, but not always, causes the deposition of the substance. It is well known that water may be cooled in a still vessel below 32° without freezing, but a little agitation produces congelation of a part of the water in long fibrous or laminated crystals. The stream of water is cooled to the freezing point, and by the cold of the night its temperature is still further reduced. In this state the caloric is more than saturated, and the stones and wood under the water perform the part of the substances introduced into the solution of salt, and the ice forms upon them. The quantity of anchor-ice formed would be small, for an obvious reason. Every pound of water frozen would evolve 142° of caloric, which would raise 142 pounds of water one degree, or 71 pounds two degrees. Allowing the temperature of the stream to be reduced to 31° or 30° , the congelation of a relatively small quantity would thus prevent further congelation, while the crystals of ice would be formed under water, where the solid bodies, as stones and wood, are. Considering how poor a conductor wood is, it can hardly be supposed that anchor-ice is formed on solid bodies merely because they are better conductors of caloric than water is, and the more so, because they must have the same temperature as the water. Rocks sometimes pass from a frozen bank, by connection with which their temperature may be as low as 20° , into and under water, which congeals on them because they are so cold, and thus forms solid ice. This is not a case of anchor-ice, nor has it the form of that ice. Neither is that anchor-ice caused by a rock projecting above the surface and congealing the water into solid ice around it. — *Prof. Dewey, in Silliman's Journal for Sept.*

DISCOVERIES OF GOLD IN 1850.

In Indiana. — At the meeting of the Franklin Institute on May 17, a letter was read from Prof. Wylie of the University of Indiana, announcing the discovery of gold in the beds of the rivulets in Morgan, Jackson, Brown, and Green Counties of that State, composing a district about 40 miles by 24. It is always in connection with a black

sand, which is found at the bottom of the streams, generally at the upper end of sand-bars. The sand having been separated from the coarse gravel, on examining it closely with the microscope, there appear interspersed through it red particles of different shades, and some few yellow and green particles; of the former, some appear to be colored quartz, while others are garnets and probably pyrope. The black particles are readily separated into two sorts by the magnet; one of these is evidently magnetic oxide of iron, while the other agrees precisely with Dr. Thompson's description of titanate of iron, or menaccanite. The gold is in flat scales. This new gold field is not likely to prove profitable for working, but is interesting in a geological and mineralogical point of view. — *Journal of Franklin Institute, June.*

Quartz rock, containing disseminated particles of gold, has been noticed during the past summer, as having been obtained from various localities in the Lake Superior mining region. This, however, is not the first discovery of gold on the lake; geologists have detected it in several instances, and the late Dr. Houghton was confident that gold would be found in considerable quantities; and it has been supposed, from minutes made by him and from remarks on the subject, that he knew more about its location than any one else, and even much more than he had ever made known.

In New Grenada. — M. Boucard, in a paper presented to the French Academy upon the geology of the provinces of Panama and Veraguas, in New Grenada, observes that the igneous rocks, whose upheaval has formed the Cordilleras, are frequently penetrated by veins of auriferous quartz, running north and south. The hard rock which composes these veins has resisted atmospheric influences better than the surrounding rock, and the veins consequently project so as to be easily seen. The proportion of gold very rarely amounts to one 2,000th, which is of course too small to pay for working.

GEOLOGY OF THE CALIFORNIA GOLD REGIONS.

NEAR the summit of the Sierra, granite is the prevailing rock. On the flanks of the mountains and in the valleys, metamorphic and igneous rocks occur, with occasional veins of trap, having a close, compact structure. There was by no means so great a variety of metamorphic rocks observed on the western flanks of the Sierra as might have been expected. North of the American River, no others were seen but varieties of talcose slates and argillites. Between the Cosumes and the Calavares Rivers there were, in addition, hornblende and hard silicious talcose slates. This latter region also furnished testimony to a greater intensity of the action of heat in the greater abundance of indurated slates. The extensive region throughout which these slates abound shows that they once occupied a large area, which has been materially lessened by the intrusion of masses of igneous rocks in innumerable places. The intrusive rocks in this region are chiefly trap, sienite, porphyry, and serpentine. The region between Feather River and the American River bears evidence of having become quiescent, or nearly so, long before the *comparatively* recent period, when the country

south of the Cosumes was in a state of disturbance produced by a most energetic action of internal forces, which have brought to the surface lava, tufa, &c. These volcanic masses do not seem to have been produced during the era in which the intrusive rocks between the American and Feather Rivers were formed. Still further north, volcanic action continued also to a later period, as well as further southeasterly. On the Stanislaus, vast developments of basalt are reported to exist. Near the Mokelemy River there is evidence to show that the sedimentary rocks have been uplifted 2,000 feet at least since their formation, which is certainly not *anterior* to the eocene period. North of the country between the Russian River and the Laguna, lofty volcanic peaks are said to exist along the coast range. Southwest of San Francisco, the mountains also attain a considerable altitude, and furnish ample testimony of volcanic action. This region contains the mines of cinnabar; also ores of silver and copper. Many of the reports of the existence of cinnabar in California owe their foundation to the occurrence of rocks colored red by peroxide of iron. Lead ore occurs north of Sonoma. The gold-bearing slate rocks, which are the prevailing rocks upon the flanks of the Sierra Nevada, extend northwardly into Oregon, where it may also be expected that gold will be found. Circumstances favorable to the occurrence of gold exist in that Territory. These may be briefly stated to be the existence of veins of quartz in slates, in the vicinity of, or penetrated by, rocks of igneous origin.

In regard to the extensive distribution of gold in California, some writers have attributed it to volcanic action. For this belief, Mr. Tyson remarks, there is not the slightest foundation. Gold abounds, it is true, among the detritus of slate valleys near the volcanic region of the Mokelemy River; but it is not mixed with any of the volcanic products of the vicinity. In the extensive auriferous region along the Yuba, for a distance of 70 miles, there is a total absence of all volcanic products. Gold occurs in other countries under precisely the same circumstances as it exists in California. On the Atlantic slope of the United States, it was first discovered in Georgia (where there are no volcanoes) among transported stony matter in ravines, and subsequently traced to the vein in slate, in which it is known to exist as far north as Maryland. *Larger pieces of gold have been found in North Carolina than have yet been actually seen in California*; but whether the smaller amount produced is owing to the destruction of a less amount of rock and its included veins, or whether the metalliferous veins are fewer in number and less rich than those in California, we have no means of determining. Mr. Tyson is of the opinion, that the whole extent of the Sierra Nevada has on its western flank metalliferous veins, in a belt of country varying in width from 30 to 40 miles, at least in that portion between the Yuba and the Stanislaus. The mountains of the coast range contain, perhaps, several metalliferous regions, separated from each other.

Calculating from the amount of gold sent out from California, and from the number of persons engaged in mining, Mr. Tyson conclusively shows, that the average yield per day to each person engaged

in gold-seeking has not exceeded in value \$3.00, a sum which will barely pay the expenses of living in that country.

As regards the evidence of diluvial action in California, Mr. Tyson says, — "The boulders scattered in the region of the Mokelemy, even on the highest grounds, prove that the vast floods which prevailed during a former period in the earth's history, and which bore icebergs from the northward, over Europe, Asia, and the northeastern portion of North America, also carried them over parts of California." It was during this era, that the large valleys along the California rivers were formed, by the removal of conglomerates, sandstones, &c., sometimes to the extent of twenty miles in area. During this erosion, the gold in the veins of the rock destroyed was liberated, and borne by virtue of its great specific weight to the bottom of ravines, where the force of the currents and great depth of the torrents were sufficient to leave nothing else of less comparative weight behind. As these currents decreased in force, the heavier stony fragments began to be deposited, and mix with, and cover the auriferous and other metallic substances: but the gravel and sand continued on, and formed the immense beds now seen upon the rolling country at the foot of the mountains, while much of the finer materials was carried further, even into the ocean itself, through openings probably formed at that period in the coast range.

There is a tradition among the Indians to the effect, that the narrow strait which connects the ocean with the Bay of San Francisco was effected within a recent period (about four generations ago) and that it was *suddenly* done. Much greater effects than the sinking of a sufficient area to have opened this narrow passage have been produced by earthquakes within the last 200 years. Besides, the coast range bears incontestable marks of being within a district wherein internal disturbing forces have acted with violence sufficient to produce earthquakes of great energy during *very recent* geological periods; and there is no reason to suppose that these apparently slumbering causes may not at intervals manifest themselves by producing visible changes upon the face of the country. Its geological structure indicates that it is within the great region of volcanoes and earthquakes, which embraces nearly all Western America. — *Tyson's Report on the Geology of California.*

CALIFORNIA GOLD MINING.

FROM various statements published during the past year, we learn that several successful attempts have been made, and are now in progress, to work the gold-bearing quartz of California in a regular and systematic manner. The position and extent of the gold-bearing quartz at Mariposa Creek, where mining operations have been commenced under the direction of Messrs. Stockton and Aspinwall, are thus described by Mr. Forrest Shepherd. He says: —

"The quartz vein varies from three to six feet in thickness, and runs nearly E. and W. in walls of talcose slate. It has a slaty structure similar to the neighbouring rock, and dips to the south at an angle of about eight degrees. A shaft has been sunk to the depth of twenty-

seven feet, and rich specimens taken from the body of the vein, from the top to the bottom, when the gold was left descending with the earth to an unknown depth. The vein at the foot of the hill has been opened by adits run in on the course of the vein at several places at different heights, and at all these places the gold is found very equally distributed through the rock. In numerous instances the gold is visible to the eye, and seen in very small points, yet in a great mass of the rock there is none visible externally; but on pounding it in a mortar to a fine powder, and washing it, the yield of gold is so abundant as to remove all doubt as to the propriety of working the rock by machinery." The *San Francisco Herald*, in a notice of some of the specimens from the locality, says, — "Several lumps were selected, in which no particle of gold could be discovered, even with a microscope. These were pounded in a mortar, and when reduced to a fineness somewhat less than that of common table-salt, were washed in a rude tin pan. Each piece yielded, when so reduced, several grains of gold. The estimated product was twelve cents to the pound of rock."

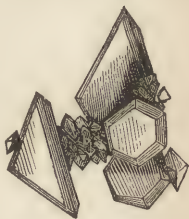
Mr. Tyson, in his report to the Secretary of War on the geology of California, says, — "It is not to be expected that the quartz veins throughout the gold region will generally prove metalliferous; on the contrary, but a small proportion of the whole number can be expected to contain metal worth working." He observes that Col. Fremont showed him a specimen from Mariposa River which contained a large proportion of gold disseminated in small masses throughout the stone, but he evidently is of the opinion that the question as to the profitable working of the veins remains to be decided.

CRYSTALLIZED GOLD FROM CALIFORNIA.

MR. FRANCIS ALGER, of Boston, has recently obtained some crystals of gold from California, which exceed in size any heretofore discovered in any localities. The crystals were brought from California in two separate parcels, by Mr. G. E. Tyler of Boston, and Mr. H. B. Platt of New York. They are well characterized octahedrons, simple and modified, the surfaces of which have been but slightly disfigured by attrition, or the effects of transported action usually observed in other specimens. As examples of crystallization, some of the specimens are as perfect as are to be seen in magnetic iron ore or spinelle. The most striking examples on a large scale, are three octahedrons of the dimensions of the accompanying figures. They are isolated crystals, and the



smallest one, which is the most perfect, is so entirely free from any adhering portion of the matrix to which it must have been attached, as to lead to the belief that this matrix was a much softer material than the quartz in connection with which the gold is usually found. The exact locality of this crystal is not known. It presents four pretty regular faces, and has three of its solid angles perfectly formed to a point. One of the faces is depressed by a very deep cavity, which extends not quite to the edges of the plane, but so near them as to leave a narrow ridge, or border, all around the cavity and parallel with the edges, thus giving the same triangular outline to each. It appears as if the crystal had been in a liquid state, and that soon after the outside had congealed, the inner portion, or a part of it, had run out, leaving the surrounding consolidated edge referred to. Something similar to this takes place in the formation of artificial crystals. Some of the crystals of gold in possession of Mr. Alger are maces, and present rare and curious forms. The accompanying figure represents one of the most remarkable of these forms. The great size of the crystals, and the fact that some of the cavities contained portions of oxide of iron, probably produced by the decomposition of pyrites, have led some to regard them as pseudomorphs of sulphuret of iron. "I am not disposed," says Mr. Alger, "to ascribe any such forced and unnatural origin to these beautiful productions. I believe them to have been formed under the ordinary circumstances of crystallization, either in an open space or while surrounded by a matrix so soft and accommodating, as to allow them full freedom to take the form it was intended they should take."



Mr. Teschemacher, at the Boston Natural History Society, April, observed that some of the octohedrons of gold in possession of Mr. Alger measured five sixteenths of an inch at the base of the pyramid. He had never seen crystals from other localities exceeding one sixteenth of an inch, and thought that this circumstance was an indication that the gold deposits in California were far larger than any hitherto explored.

The largest of the crystals referred to were obtained from a very choice and beautiful collection of specimens, made with great care, and no small expense, by Mr. Platt of New York. This gentleman, during a residence of two years in San Francisco, and while occupying a situation which brought him in contact with persons returning from the mines, has purchased the most interesting specimens obtained by them. He has consequently been rewarded by the finest collection hitherto brought from California. It comprises a great variety of ramified, arborescent, dendritic, and other imitative forms, here and there showing crystalline faces, all of them being sometimes most fantastically joined together in the same specimen. In obtaining this collection, Mr. Platt states that he examined gold to the value of more than four millions of dollars.

NEW METALLIFEROUS DEPOSITS.

Dr. JACKSON has communicated to the Boston Society of Natural History the fact, that the plumbaginous mica slates of Vermont contain a considerable portion of tin diffused through their mass, in a state of combination not yet determined. The specimens examined were from two localities, and yielded a considerable quantity of an alloy of tin and iron when fused in a crucible lined with lampblack. Specimens of the rock were exhibited by Dr. Jackson, with globules of the metal extracted from it. This discovery is an important one, as it points to the probable occurrence of tin ores in districts where they never were suspected to exist. For if an extensive rock formation is filled with tin in some state of combination, veins of the oxide or sulphuret cannot fail to exist somewhere. Pieces of plumbaginous slate, so full of graphite as to prove valuable as plumbago, have been recently analyzed in Dr. Jackson's laboratory, and yielded malleable grains of an alloy of tin and iron.

Dr. C. T. Jackson has discovered, in Labrador felspar from Franklin, N. J., small black crystals, which contain oxide of cerium, similar to that obtained from ores found in Sweden.

A communication in *Silliman's Journal*, for March, from Dr. F. B. Hough, states that he has discovered sulphuret of nickel at the Sterling Mine, in Antwerp, Jefferson Co., N. Y. "It occurs mostly in radiating tufts of exceedingly minute and slender crystals of a brass-yellow color, and very brilliant lustre, which, when highly magnified, present the appearance of flattened hexagonal prisms with striated faces, the striæ being parallel with the principal faces of the prism. It occurs in geode-like cavities of the iron ore, which are lined with crystallizations of spathic and specular iron, quartz, calcite, cacoxene, and sulphuret of iron; from among these the tufts proceed, attached generally to the spathic iron, more rarely to the crystals of iron." It is by no means abundant. Minute crystals are found penetrating and traversing the spathic iron.

Platinum has recently been discovered in several localities in the Alps, by M. Gueymard. It occurs in very minute quantities associated with gray copper ore, in a gangue of delomites, quartz, gneiss, and limestones. Some indications of rhodium have also been noticed in specimens obtained from the platinum localities. It is found in three different localities. — *Comptes Rendus*, Dec. 31, 1849.

At the Boston Natural History Society, April 17, Mr. Teschemacher exhibited some grains of platinum from the washings on the Feather River, California, with the gold from which he had picked them out, several grains still remaining mixed therewith. These platinum grains from California appeared to resemble those from South America, the Russian platinum being less rounded and flattened by attrition.

LAKE SUPERIOR IRON DEPOSITS.

THE following mention is made of the iron deposits near Lake Su-

perior, in a late report of the United States Geologists: — “The beds are found on a scale of such magnitude, and the ore is of such purity, that it requires little search to discover them, and little caution in pronouncing on their value. This iron region is perhaps the most valuable and extensive in the world, for the manufacturing of the finer varieties of wrought iron and steel. When we consider the immense extent of the district, the mountain masses of ore, its purity and adaptation to the manufacture of the most valuable kinds of iron, and the immense forests which cover the surface, suitable for charcoal, this district may be pronounced unrivalled. The iron occurs in a metamorphic formation bounded by two granite belts, one on the north and the other on the south, and it is prolonged westerly beyond the Machiganig River. This formation consists of hornblende, talcose, and chlorite slates, with associated beds of hornblende and felspar rocks, evidently trappean in their origin. The ore consists mainly of the specular, or peroxide of iron, with an admixture of the fine-grained magnetic. In some instances, *the whole ridge or knob appears to consist of one mass of PURE ORE*, — so pure that no selection is required, but an unlimited quantity might be quarried, or picked up in loose blocks around the slopes. In others the ore is mixed with seams of quartz or jasper, which renders it less valuable, and requires more care in the selection. The iron, in such cases, presents a banded structure, or alternating seams of steel-gray and brilliant red. The appearance of a mountain cliff thus made up is extraordinary.

“This region possesses an inexhaustible supply of iron ore, of the best quality, removed from twelve to thirty miles from the lake shore, with a soil by no means sterile, and covered with a heavy growth of maple, yellow birch, pine, and oak, — and that it is *to this source that the Great West will ultimately look for the finer varieties of bar iron and steel*. This region also contains extensive beds of marble. Flesh-red is the prevailing tint, with veins of a deeper hue. The Novaculite slates are valuable, affording hones equal to the Turkey or Scotch stones. In the iron region, the Jackson Company was the first to commence the manufacture of blooms and bar-iron. They have now two forges in successful operation, producing 2,000 lbs. of blooms per day, at an expense of little over \$21 per ton. Their forges are located on Carp River, about ten miles from the lake shore.”

AMERICAN LEAD AND COPPER.

APPENDED to the geological report of Dr. Owen, United States Geologist for Wisconsin and Iowa, is a table showing the actual recorded shipments of lead from Galena from the year 1841 to 1847. It is as follows: — Number of pigs of lead shipped in 1841, 452,814; 1842, 447,859; 1843, 561,321; 1844, 624,601; 1845, 778,460; 1846, 730,714; 1847, 771,679. As a pig of lead will weigh, on an average, 70 pounds, it appears from the above table that the annual produce has varied, in the seven years referred to, from 32,000,000 lbs. to 54,000,000 lbs. A correspondent of the *New York Journal of Commerce* furnishes a comparative statement of the receipts of pig lead

in the principal Atlantic cities for the last four years. From May, 1846, to May, 1847, the receipts were, of American, 509,018; for the corresponding period of 1847-48, the receipts were 623,373 lbs. American; for 1848-49, 590,527 American, and 14,650 foreign; for 1849-50, 481,800 American, and 440,000 foreign. The receipts now are stated to be almost wholly of foreign lead.

The *Lake Superior Journal* estimates that 2,680,000 lbs. of copper in the rough will have been sent down from Lake Superior before the close of navigation. About 1,000 men will be employed during the winter. Seven large masses were shipped at one time, whose united weight was 29,852 lbs., while four others weighed 14,641 lbs.

NOTES FROM DR. JACKSON'S REPORT ON LAKE SUPERIOR.

DR. JACKSON, in his elaborate report on the mineral region of Lake Superior, mentions many interesting facts. At the office of the Copper Falls Company he saw the "finest crystals of metallic copper in the world." In the collection he found a curious variety of analcime, of a salmon-red color, presenting the singular form of a long rhombic prism, as if pseudomorphic. The terminations of these crystals are trihedral, the inclination of the planes on each other being about 100° . This mineral, on analysis, proved to be a mixture of leonhardite and analcime. It occurs in crystallized calcareous spar, traversing the rhombic masses of that mineral, and is associated with regular crystals of analcime and leonhardite.

At the North American Company's location, Dr. Jackson gives some observations upon the water in the mine at different depths, and remarks, — "From these observations, and those I have made at different seasons of the year, it will appear that the mines which have penetrated to a depth of one hundred feet have a uniform temperature of 44° F., and that the temperature is not affected by the heat of summer, though it is probable that in winter the cold air may penetrate into the mines, and affect the temperature of the air. The mean annual temperature of the climate is 42.1° F., according to observations at Fort Wilkins." At the Boston and Pittsburg Company's mines, which are quite near the last mentioned, Dr. J. "measured the temperature of the water in all parts of the mine. At 60 feet depth from the surface, the water was 44° F.; at 120 feet, it was 44° ; at 180 feet, it was 43° ; and at 236 feet, it was 45° . From these observations, it will appear that this mine has already reached a sufficient depth to be affected by the heat of the earth's interior. If we regard 43° as the mean temperature of the climate, we shall have a rise of one degree for 88 feet in depth. These mines are the best places for investigating this subject, for there being no pyrites or sulphurets, or any mineral decomposing capable of producing heat thereby, we are free from the objection made to some of the European experiments on the increase of temperature in mines." — *President's Message for 1849, Part 3.*

ON THE GEOLOGY AND MINERALOGY OF EMERY.

FROM a communication in *Silliman's Journal* for November, by Dr. J. Lawrence Smith, we derive the following facts relative to the nature of emery. Of all the mineral substances employed in the arts, few have offered so little opportunity for geological examination as emery, and consequently our knowledge of it is very limited. Previous to 1846, emery (which term is here used to express that mixed granular corundum employed for abrasion), although known to exist in various places, was supplied almost entirely from the island of Naxos in the Grecian Archipelago. The emery from this place frequently went under the name of Smyrna emery, from the fact of its being shipped from that port. Since 1846, this mineral has been discovered in large quantities *in situ*, in the vicinity of Smyrna and Ephesus, Asia Minor, by Dr. Smith, while engaged in the service of the Turkish government.* It occurs associated with metamorphic limestone, wholly devoid of fossils, and overlying mica, slate, and gneiss. It is imbedded either in the earth that covers the limestone or in the rock itself; and exists in masses from the size of a pea up to several tons' weight, generally angular, sometimes rounded; when in the latter form, they do not appear to have become so by attrition. In the opinion of Dr. Smith, this emery has been formed and consolidated in the limestone in which it is found, and not derived from the older contiguous rocks, granite and gneiss, and lodged in the limestone at the period of its formation. In the process of segregation, which has given rise to the production of the mineral, it would appear that silica, alumina, and oxide of iron were eliminated from this calcareous rock, and these three in the exercise of homogeneous and chemical attractions have given rise to the minerals which constitute and are associated with emery. Emery has been considered by some as corundum; others suppose it to be represented by some rock or other, not always the same, in which corundum is disseminated in greater or less quantity; others, again, consider it a mixture of corundum and oxide of iron. To this latter view Dr. Smith assents. Emery has not the aspect of corundum disseminated in a rock, for it is found in distinct masses of different dimensions and great hardness. Most frequently, there is no other evidence of the presence of corundum in emery than its hardness. The oxide of iron present is always under the form of magnetic oxide more or less mixed with oligist; sometimes it is titaniferous. The fracture of emery is tolerably regular, and the surface exposed is granular and of an adamantine aspect; it is exceedingly difficult to break when not traversed by fissures. When reduced to powder it varies in color from that of a dark gray to black. The color of the powder, however, affords no indication of its commercial value. When examined under the microscope, the powder shows the distinct existence of two minerals, corundum and oxide of iron, which appear inseparable, as the smallest fragment contains the two together.

The hardness of emery is its most important property, as to it is

* See *Annual of Scientific Discovery*, 1850, p. 265.

due its value in the arts. The method adopted by Dr. Smith for determining the hardness of different varieties is by observing the abrasion caused by the rubbing of a definite amount of emery upon the surface of glass with the bottom of an agate mortar, the abrasion caused by pulverized sapphire being taken as a unit of comparison. By this method the best emery is found capable of wearing away about one half of its weight of common French window-glass, the sapphire under the same circumstances wearing away four-fifths of its weight. In its chemical composition, emery consists of alumina, from 60 to 77 per cent.; oxide of iron, from 8 to 33 per cent.; lime, from 0.40 to 2.80 per cent.; silica, from 1.80 to 9.63 per cent.

The mining of emery is of the simplest character. The natural decomposition of the contiguous rock facilitates its extraction in blocks and large masses, which are afterwards broken by hammers into a convenient size for transportation by camels or horses. In some localities the mining is attended with great difficulty, as the tools used for boring are rendered unfit for use by coming in contact with pieces of emery. The annual consumption of emery at present is about fifteen hundred tons. The price at the end of the last century was from 40 to 50 dollars per ton, and between 1820 and 1835 it was at times even less. About this period, the monopoly of emery in the island of Naxos was purchased from the Greek government by an English merchant, who so regulated the quantity given to commerce that the price gradually rose from 40 to 140 dollars the ton, a price at which it was sold in 1846. Since then, the emery mines discovered by Dr. Smith in Asia Minor have been so successfully worked, under the auspices of the Turkish government, that the price has now diminished to 50 and 70 dollars per ton, according to the quality.

ON RUTILE AND CHLORITE IN QUARTZ.

SPECIMENS of rutile in quartz have for twenty years past been found in boulders in several towns in the vicinity of Dartmouth College, none of which have ever been traced to their sources. Localities have been mentioned, but none have furnished specimens resembling these boulders, excepting a single one. This locality was opened two years since at Waterbury, on the Central Railroad. In a cut of sixty feet depth through solid talcose slate, and thirty feet from the surface, a vein of quartz was met, and a considerable number of specimens containing rutile were obtained. The locality is now exhausted, and from its position could not have furnished the scattered masses heretofore known. Some of the specimens from this region are exceedingly beautiful, both in the richness of the quartz and the abundant long needles of the rutile. The rutile crystals are from the size of the finest hair, so as to be almost invisible, up to the twelfth of an inch in diameter and five inches long; they are uniformly distributed throughout the quartz, and intersect and cross each other in all directions. There is no radiation from a centre, but in many instances the crystals have one or more large, graceful curves, and sometimes two in opposite directions, and some are bent at an angle either right or oblique. Many

are broken at the surface of the quartz, while others are wholly included in it, terminating in a single plane, or tapering to a point. They are all of a uniform bright reddish-brown color, and of the lustre of polished copper. Where the ends are seen on the polished faces they have the color and lustre of polished steel. In some specimens there are numerous, vermiform, tortuous, and convoluted crystals. They occur either singly or in groups of several laterally joined, and united in all their convolutions, and having a single terminal plane, highly lustrous, which often presents a silver-white color. These crystals, Prof. Hubbard conceives to be chlorite.

If these several minerals were at one time in the fluid quartz, they must have crystallized previous to it. The rutile prisms are so straight, or so gracefully curved and bent, that they would seem to have experienced but slight resistance. They intersect and cross each other, and pass through the loops in the chlorite crystals, or touch them upon the outside, and they probably crystallized first. Around most of these convolutions of the chlorite, there is a burr, or a minute spot of imperfectly radiating fractures, which suggests that they were formed before the solidification of the quartz, and that they had occasioned some pressure or disturbance, and a slight fracture. But as the chlorite uniformly, and the rutile in very many cases, must have been without any attachment, the density of the fluid quartz to have sustained them was probably great. There must be somewhere, in this region north, a rich deposit, for which mineralogists will earnestly seek, until it is found and its treasures transferred to their cabinets. — *Prof. Hubbard, before the American Association. Silliman's Journal, Nov.*

MINERAL PHOSPHATE OF LIME.

MR. ALGER announced to the Boston Society of Natural History, in December, the discovery in New Jersey of a valuable and extensive deposit of massive phosphate of lime. It occurs in the town of Hurds-ville, Morris County, a few miles from the Morris Canal, and is associated with magnetic iron pyrites, and rarely with copper pyrites, all together forming a vein of about eight feet in width, traversing a gneiss or hornblende rock. These metallic sulphurets occupy the lowest part of the vein, but are often penetrated by the inter-crystallization of the phosphorite, which is sometimes met with in very regular prisms of the usual hexahedral form, and several inches in length, entirely surrounded by the metallic gangue. The superincumbent portion of the vein, of about 5 feet thickness, is composed entirely of the massive and semi-crystalline phosphate, and it follows the lower portion with a pretty uniform dip and parallelism to the depth of about 30 feet, as far as it has been explored. It extends to the surface of the ground, and was opened for the purpose of obtaining pyrites for the manufacture of copperas, or green vitriol, which it was thought would pay the cost of mining, while the phosphate of lime was overlooked, or supposed to be some common rock, though the occurrence of a few crystals of the mineral, imbedded in the pyrites, had been known for some

time, and had attracted various mineralogists to the spot. There may be seen a single crystal at the house of Gov. Dickinson, which must have been more than 18 inches in length. The massive phosphorite was discovered by Dr. C. T. Jackson and Mr. Alger while on an excursion into New Jersey during the past summer. Several tons of it have been removed, and its value is now to be tested as a substitute for animal phosphate and guano, as an agricultural fertilizer, after grinding and undergoing other suitable preparations, to render it more readily solvent and active in the soil. So pure indeed is this mineral phosphate, that Dr. Jackson considers that it may and will be profitably used for the extraction and preparation of phosphorus, in preference to obtaining it from other sources. It is the intention of Mr. Alger to send to the great Exhibition of 1851 a nearly pure mass from the Hurdsville vein, weighing over 400 pounds.

So important is the substance deemed, that a few years since the British government sent commissioners to Estremadura in Spain, for the purpose of exporting it to England, and Prof. Daubeny made a report on the subject, the result of which was, that it did not occur in sufficient quantities; so that the only mineral phosphate now used by the agriculturists in England is obtained from the *crag* on the coast of Suffolk. But this is very impure, containing carbonate of lime and other earthy matter, which are objectionable in several ways, while the mineral phosphate of New Jersey is perfectly pure. Prepared bone-dust, however, is very largely used in England, and in this country the demand for it is considerable. It contains several soluble phosphates besides lime, as magnesia and soda, all of which are important to the growth of plants. Besides the use of bone-dust for agricultural purposes, several thousand tons of it are annually used in England for the manufacture of china-ware, at a cost of from £7 to £10 per ton. When we consider the bearing of phosphate of lime upon the animal and vegetable economy, we cannot but regard the discovery of this substance in such large quantities, and so easily accessible, as one of the most valuable of the sources of wealth which has been added to the country during the past year.

Phosphate of Lime in New York.—During the geological survey of New York some years since, the occurrence of phosphate of lime in considerable quantities was noticed by Dr. Emmons near Crown Point, and its employment for agricultural purposes recommended. This locality within a comparatively recent period has been explored and a vein opened under the direction of Dr. Emmons. This vein has been traced for a distance of 30 or 40 rods, and opened continuously for 30 feet. In some places it has a width of six feet, varying from two to six. About sixty tons have been already raised, which it is proposed to grind and prepare for agricultural purposes. This phosphate of lime differs considerably from apatite, and is called by Dr. Emmons *cirpyrchroite*. In color it is a dirty malachite green, apparently formed in concretions under botryoidal forms, exhibiting on the cross fracture a fibrous structure like some forms of limonite. It is foliated or laminated, the laminæ lying upon each other and forming with themselves segments of spheres. Exposure to the air changes

the green to a dirty white. When its temperature is raised to a little below redness, it phosphoresces with a fine emerald-green light. It is dull and opaque; hardness, 4; sp. gr. 3.06. Composition, phosphate of lime, 92.85; oxide of iron and alumina, 5.20; silica, 0.50; water, 1.50; fluoric acid, traces. Like the phosphate of lime in New Jersey, it occurs in a regular vein in gneiss, and is associated with primary limestone and a greenstone dike, which also contains phosphoric acid. The direction of the vein is nearly east and west; dip north at a high angle. This phosphate has been tried by Dr. Emmons upon land with great success. — *Editors.*

COAL AND OTHER FOSSIL FUELS.

At the meeting of the Geological Society, on March 13, a letter was read from the Foreign Office, announcing the discovery of coal in the district of Oltoo, thirteen hours distant from Erzeroom, Asia Minor. The coal is slaty and not of prime quality, containing considerable sulphur. — *London Literary Gazette, March.*

An interesting discovery has been made in Russia, between Dorpat and Norva, of a combustible as carboniferous and calefactory as coal. It is of a yellowish-brown color, with white spots, and is the subject of much speculation, being said to be of a much earlier geological period than any known coal-field. — *London Mining Journal, Aug. 31.*

ASHES OF ANTHRACITE COAL.

THE following communication was read at the meeting of the American Association, at New Haven, by Mr. J. B. Bunce: — Coal, now so common an article of fuel in all our cities, leaves but a small quantity of ashes; yet when we take into account the number of tons consumed in a single year, this amount becomes very considerable; hence, it is a matter of interest to know whether it can be considered of economical value. With this purpose in view, two samples of coal were selected, the white and red ash varieties, and the quantities soluble both in water and acid determined, with the following results, viz.: —

White ash, in water, . . .	3.74	Red ash, in water, . . .	3.35
“ “ in acid, . . .	17.07	“ “ in acid, . . .	18.65

The following analysis is the mean of two determinations of the portion soluble in acid: —

	White Ash.	Red Ash.		White Ash.	Red Ash.
Soluble silica, . . .	.796	8.621	Soda,	1.933	1.146
Alumina, . . .	35.201	29.575	Potash,	1.443	.732
Iron, . . .	29.643	40.614	Phosphoric acid, .	1.706	1.880
Lime, . . .	18.655	1.108	Sulphuric acid, .	8.164	3.010
Magnesia . . .	1.730	13.992	Chlorine, . . . .	.087	.013
			Total, . . .	99.448	100.691

The results obtained in these two analyses seem to justify the ex-

tensive use of coal ashes for agricultural purposes; they are very valuable on account of the sulphates of lime and magnesia which they contain, and also from the phosphoric acid and alkalies. Hundreds of tons which are now wasted might thus be brought into use.

ON THE STRUCTURE OF ANTHRACITE COAL.

It has been ascertained by Prof. Bailey, that anthracite coal is susceptible of division into very thin laminae, all of which examined under the microscope give evidence of their vegetable origin. During combustion in an ordinary coal fire, the cinders which fly off are very good for these examinations; they easily split into thin layers, and show vegetable tissues of various kinds. Even completely decarbonized coal shows this origin. The little white spots are the vessels. It is more difficult to examine soft coal, as the bitumen swells and obscures the vegetable forms. The principal forms observed are thin layers of elongated cells, scalariform ducts, flattened tubes, arranged in spiral lines, large rectangular cells, the charcoal-like masses; in one case, a scar, as if a bud had been there attached; also portions of the fronds of ferns.

ABSENCE OF THE COAL FORMATION IN CALIFORNIA AND OREGON.

In a recently printed report of the Secretary of War, communicating information in relation to the geology and topography of California, and containing a memoir on the subject by Mr. T. P. Tyson, of Baltimore, the result of a scientific visit made by him to that region, we find the following statement, which effectually contradicts the many accounts we have had of coal existing there in abundance.

"There is one drawback to the country," says Mr. Tyson, "and a most serious one, in the absence of that main spring to industrial operations in the present age, — *coal*. I had thought it not impossible that, if the Sacramento valley itself should not be ascertained to repose upon a 'coal formation,' one or more coal basins might exist among the coast range of mountains; but was disappointed in this leading object I had in view in visiting the country, by finding the strata not older than the comparatively recent periods of tertiary formations resting immediately upon the hypogene rocks, thus showing the remarkable fact of the *total absence of the entire suit of sedimentary formations* (from the tertiary down to the silurian) which form the surface of the greater portion of the known world; and, as the coal formation has its place in the midst of these, it is of course also wanting. It would be premature to assert positively that it may not exist north or south of the regions covered by my reconnoissance; but, from all the information I have been able to collect, it seems likely that the same geological features extend from near the Oregon boundary to the southern terminus of Lower California. Not having visited Oregon, I am not in possession of sufficient information to found an opinion upon as to the probability of the carboniferous formation existing in that Territory. Lignites and tertiary coals are known to exist, and it is most

likely that upon each discovery of these a 'new edition' of a 'coal report' is emitted. Whilst Col. Mason was in command in California, he considered the subject so important that 'he directed the late Capt. Warner to visit and examine every locality in which coal was reported to exist,' up to about the middle of 1848. It appears that every one of these 'numerous beds of coal of the best quality for steaming' proved to be either lignite, or bitumen, or something still further removed from the character of coal. The lignites, in most cases, were but fragments of trees, or single trees only. There is an ample coal formation on Vancouver's Island, and others on the continent further north. It is to that quarter that California must look, unless Oregon may produce it. As far as I can learn, all the reported coal-beds on the coast are of the character above described."

A seam discovered by Lieut. Talbot on the Celeetz, in Oregon, proves to be lignite.

ASPHALTUM FROM NEW BRUNSWICK.

At a meeting of the Boston Society of Natural History, April 17, Dr. C. T. Jackson called the attention of the members to a new locality of asphaltum recently discovered in Dorchester, New Brunswick. It occurs in a bed from four to six feet in thickness, and, if continuous for any extent, must furnish a vast amount of most valuable fuel. The asphaltum is a very beautiful variety, jet black, glossy, and free from smut. It breaks with a broad conchoidal fracture, like obsidian, and presents a brilliant surface. It is a little softer than rock salt, which scratches its surface. Its specific gravity is 1.007. It softens and melts when exposed to heat in close vessels. When inflamed it does not run, but burns freely with a bright, yellow flame, and a little smoke. Heated in a glass flask, it gives off an abundance of bituminous liquid analogous to petroleum, and leaves a very light and bulky coke, of a brilliant black color, and very porous. When exposed to heat in a covered platinum crucible, an abundance of carburetted hydrogen gas is given off, which burns with a large and brilliant yellow flame, having a high illuminating power. Two analyses gave an average of 59 per cent. volatile matter to 41 of coke. Asphaltum is particularly valuable for the production of gas for illumination. It is also the best fuel for steam-engines, and is particularly well adapted for the use of locomotives on railroads. The asphaltum in question has been used with great success at the Boston Gas Works. Its geological position was stated by Dr. Jackson to be above the coal formation of New Brunswick.

THE KOH-I-NOOR, OR GREAT EAST INDIA DIAMOND.

DURING the past year, the celebrated diamond of the East Indies, known as the Koh-i-noor, which had by the right of conquest fallen into the possession of the British government, has been transferred to England. The history of this splendid gem is as follows:—It was discovered in the year 1550, before the establishment of the Mogul dy-

nasty, in the mines of Golconda. It remained in the possession of the King of Golconda until the time of the father of the renowned Emperor Aurungzebe, who, subjugating its possessor, first held the Koh-i-noor by the right of conquest. While in the possession of the Moguls it was first seen by a European, Tavernier, a French traveller, in 1665. This gentleman, as an act of indulgence on the part of Aurungzebe, was permitted to examine it minutely, and from the account which he gave of it, it has since been known to the European world as the diamond of the Great Mogul. In this interview the Emperor is described as seated upon the throne of state, while the chief keeper of his jewels produced his treasure for inspection on two golden dishes. The magnificence of the collection was indescribable, but conspicuous above all in lustre, esteem, and value, was the Koh-i-noor. Sometimes worn on the person of the Moguls, sometimes adorning the famous peacock throne, this jewel was safely preserved at Delhi until, in 1739, the empire was overthrown by the Persians, under Nadir Shah. Together with the spoils of conquest, estimated at ninety millions sterling, the Koh-i-noor was transferred to Khorassan. Here it was not destined to remain for any length of time. Nadir Shah was assassinated by his subjects, and the diamond was borne away by a party of Affghan soldiers, under Ahmed Shah, to their own country. It seems as if the Koh-i-noor carried with it the sovereignty of India, for the conquests and power of Ahmed soon became as extensive as that of his predecessors, and gave to him the control of Hindostan. In his dynasty the diamond remained until the year 1800, when its then owner, Zemaun Shah, was overthrown by Shah Shuja and imprisoned. But the usurper on ascending the throne was not able to find the precious ornament; the treasury of Cabul was searched in vain, until, at last, it was found ingeniously secreted in the prison wall of the dethroned monarch. Eight years after, the Shah Shuja had become so powerful that the British government sent Mr. Elphinstone as an ambassador to his court, for the purpose of maintaining friendly relations. At the audience given to the envoy, Shah Shuja appeared magnificently arrayed in a green tunic, glittering with gold and precious stones, and wearing the Koh-i-noor in a bracelet upon his right arm. This was the second time that a European had been favored with a sight of it, one hundred and forty-three years having elapsed since its exhibition to Tavernier. Hardly, however, had Mr. Elphinstone left the court, when the Shah was expelled from Cabul, carrying away the far-famed diamond concealed about his person. After many vicissitudes of exile and contest, he at length found an equivocal refuge among the Sikhs. Runjeet Singh, the chieftain, was fully competent to protect or restore the fugitive, but he knew or suspected the treasure in his possession, and his mind was bent upon acquiring it. He put the Shah under strict surveillance, and made a formal demand for the jewel. The Shah hesitated, prevaricated, temporized, and employed all the artifices of Eastern diplomacy, but in vain. Runjeet resorted to more stringent measures, and at last a day was fixed for the surrender of the diamond (June 1, 1813). The two princes met in a room appointed for the purpose, and took their seats

upon the ground. A solemn silence then ensued, which continued unbroken for an hour. At length Runjeet's impatience overcame the suggestions of Eastern decorum, and he quickened the memory of the Shah. The exiled prince spoke not a word in reply, but calmly motioned to an attendant, who produced a small roll which he placed midway between the two chiefs. Again a pause ensued, when, at a signal from Runjeet, the roll was unfolded, and the glittering Koh-i-noor passed into his possession. After this time it remained with the Sikhs, until the late insurrection, when it was seized by the English government. For a few years previous to its seizure, the Koh-i-noor had formed a part of the decorations of a hideous idol, kept at Orisea. Its loss is regarded by the superstitious natives as indicative of the complete extinction of their supremacy.

If we except the somewhat doubtful claims of the Brazilian stone among the crown jewels of Portugal, the Koh-i-noor is the largest known diamond in the world. When first given to Shah Jehaun it was still uncut, weighing, it is said, in that rough state, nearly 800 carats, which were reduced by the unskilfulness of the artist to 279, its present weight. It was cut by Hortensio Borgis, a Venetian, who, instead of receiving a remuneration for his labor, was fined 10,000 rupees by the enraged Mogul. In form it is "rose cut," that is to say, it is cut to a point in a series of small faces or "facets," without any tabular surface. A good general idea may be formed of its shape and size by conceiving it as the pointed half of a small hen's egg, though it is said not to have risen more than half an inch from the gold setting in which it was worn by Runjeet. Its value is scarcely computable, though two millions sterling has been mentioned as a justifiable price, if calculated by the scale employed in the trade. The Pitt diamond, brought over from Madras by the grandfather of Lord Chatham, and sold to the Regent Orleans in 1717 for £ 125,000, weighs scarcely 130 carats; nor does the great diamond, which supports the eagle on the summit of the Russian sceptre, weigh as much as 200.

ON THE GREAT DIAMOND IN POSSESSION OF THE NIZAM.

At a meeting of the Asiatic Society, in November, Capt. Fitzgerald presented a model of a large diamond found in the Nizam's country some twelve or fourteen years ago, under circumstances of rather a curious nature. The model shown, was the model of a part only, a piece having been chipped off, which, after passing through many hands, was purchased by a native banker for 70,000 rupees. The larger piece, represented by the model, is now in the possession of the Nizam, and at the time of its discovery was exhibited to many European gentlemen. The manner in which this diamond was originally found may be considered interesting. It was first seen in the hands of a native child, who was playing with it, of course ignorant of its value. On eight annas being offered for what the poor people considered as a mere stone, their suspicion was excited, which led ultimately to the discovery of the bright stone being a real diamond. The

size of the stone, exactly measured from the leaden model, is as follows : — Length, 2.48 inches ; greatest breadth, 1.35 inches ; average thickness, 0.92 inch. The actual weight of the diamond is supposed to be 1,108 grains, which is equal to 277 carats of weight of the rough diamond ; but as the rough stones are usually taken to give but one half of their weight when cut and polished, it would allow $138\frac{1}{2}$ carats, or a weight between the Pitt or Regent diamond ($136\frac{1}{2}$) and that of the Grand Duke of Tuscany (139), for it in its present condition. If we take it that one eighth of what it would have been when polished was taken off with the splinter sold to the native, we shall then have $155\frac{1}{2}$ carats for the possible weight of it, if it had been cut and polished when entire. This would place it in weight between the Tuscan and the great Russian diamond of 195 carats, which last is well known to be an Indian stone. — *Silliman's Journal*, May.

ON THE PELOROSAURUS, AN UNDESCRIBED GIGANTIC TERRESTRIAL REPTILE.

DR. MANTELL, of England, has for a long time entertained the idea, that, among the remains of colossal reptiles obtained from the Wealden strata, there were indications of several genera of terrestrial saurians, besides those established by himself and other geologists. The recent discovery of an enormous arm-bone, or humerus, of an undescribed reptile of the crocodilian type, in a quarry of Tilgate Forest, Sussex, and some remarkable vertebræ not referable to known genera, have induced him to publish the facts which his late researches have brought to light.

The humerus above mentioned was found imbedded in sandstone, about twenty feet below the surface ; it presents the usual mineralized condition of the fossil bones from the arenaceous strata of the Wealden. It is four and a half feet in length, and the circumference of its distal extremity is thirty-two inches. It has a medullary cavity three inches in diameter, which at once separates it from marine saurians, while its form and proportions distinguish it from the humerus of the *Iguanodon*, *Megalosaurus*, and the like. It approaches most nearly to the crocodilians, but possesses characters distinct from any known fossil genus. Its size is stupendous, far exceeding that of the corresponding bone of the gigantic *Iguanodon* ; the name *Pelorosaurus* (from $\pi\epsilon\lambda\omicron\rho$, monster) is therefore proposed for the genus. No bones have been found in such contiguity with this humerus, as to render it certain that they belonged to the same gigantic reptile ; but several very large caudal vertebræ of peculiar characters, collected from the same quarry, are probably referable to the *Pelorosaurus*. As to the magnitude of the animal to which the humerus belonged, Dr. Mantell, while disclaiming the idea of arriving at any conclusions from a single bone, states, that in a Gavial eighteen feet long the humerus is one foot in length ; i. e. one eighteenth part of the length of the animal, from the end of the muzzle to the tip of the tail. According to these measurements, the *Pelorosaurus* would be eighty-one feet long, and its body twenty feet in circumference. Even if we should assume the

length and probable number of the vertebræ as the scale, although we should have a reptile of relatively abbreviated proportions, yet in this case the original creature would surpass in magnitude the most colossal of reptilian forms. In this connection Dr. Mantell offers some comments on the probable physical condition of the countries inhabited by the terrestrial reptiles of the secondary ages of geology. The highly organized land saurians appear to have occupied the same position in those ancient faunas, as the large Mammalia in those of modern times. The trees and plants whose remains are associated with the fossil bones manifest, by their close affinity to living types, that the islands or continents on which they grew possessed as pure an atmosphere, as high a temperature, and as unclouded skies, as those of our tropical climes. There are, therefore, no legitimate grounds for the hypothesis in which some physiologists have indulged, that during the "Age of Reptiles" the earth was in the state of a half-finished planet, and its atmosphere too heavy, from the excess of carbon, for the respiration of warm-blooded animals. Such an opinion can only have originated from a partial view of all the phenomena which these problems embrace; for there is as great a discrepancy between the existing faunas of different regions, as in the extinct groups of animals and plants which geological researches have revealed. — *Silliman's Journal*, May.

FOSSIL TURTLES.

A REMARKABLY fine chelonite, by far the most perfect specimen of the kind ever found in the Purbeck beds, has been discovered in the newly-constructed Feather Quarry. The two portions of the shield of the turtle are situated side by side, and the carapace, or upper shield, presents its superior surface to view. It is perfect, with the exception of the posterior neural, and one costal plate; it is $15\frac{1}{2}$ inches long, and $11\frac{1}{2}$ broad. The plastron, or under shield, is less perfect, being defective at the anterior and right lateral portions; it is 13 inches long, and $11\frac{1}{2}$ broad. But what is remarkable, the under or inferior surface is uppermost on the stone, whilst the carapace presents the upper or superior surface, which renders it doubtful whether the two portions belonged to the same individual or not, although the dimensions of both perfectly correspond. The specimen might, in all probability, be referred to the genus *Emys*, but the species does not appear to have been hitherto known, as it is totally different from any described by Professors Owen and Bell, in their *Monograph on Fossil Reptilia*. — *London Mining Journal*, July 20.

Among the casts of a set of Himalaya fossils recently presented to the Boston Society of Natural History by the British East India Company, were a cranium, humerus, and parts of the sternum of *Colossochelys Atlas*, which must have been of an immense size. With reference to this, Prof. Agassiz observed, that he had found at Philadelphia a femur of a gigantic turtle, taken from the green-sand of New Jersey, which he thinks must have been larger than the Himalaya species, judging from the size of the femur, which was larger than that

of the rhinoceros; he had named it *Atlantochelys*. — *Boston Natural History Society*.

NEW FOSSILS IN THE POSSESSION OF DR. MANTELL.

A LETTER from Mr. Mantell, of London, published in *Silliman's Journal*, for January, 1851, states that he has received a letter from a friend, in New Zealand, in which the writer says, that, having heard of caves containing birds' bones, he visited one of them, and was rewarded by obtaining several skulls and mandibles. "The beak is not like the *Keivi* (Apteryx), but resembles that of the ostrich or cassowary. The cave is on the west side of the North Island, in the limestone formation which extends along the coast." There are many similar caves said to contain birds' bones. The natives believe that the country was once set on fire by the eruption of a volcano, and that all the Moas fled to a cave for refuge and there perished. This tradition Dr. Mantell considers as confirmed by various evidence, at least as far as relates to the Middle Island.

Among the fossil shells received from Mr. Walter Mantell are species of *Cucullæa* collected in the North Island, apparently identical with *Cucullæa decussata* of England.

Dr. Mantell writes that he has himself obtained from the Wealden some highly interesting and novel remains of the colossal reptiles that were contemporaries of the *Iguanodon*. He has also discovered an abundance of fossil cones, the fruit or seed-vessels of the fir-trees composing the forests of the Wealden. He has besides a beautiful fossil palm-leaf from the tertiary strata of the Isle of Wight, being the first species of this kind found in England.

FOSSILS IN FRANCE.

In the *Comptes Rendus*, for May 13, M. Paul Gervais notices some fossils obtained from a rich bed in the environs of Apt (Vaucluse). Among them are two mammals which differ generically from any hitherto known. They are very imperfect, but the animals to which the bones belonged were *Pachydermata*, ranking, the one among the *Lophiadons* and *Tapirs*, the other among the *Pachydermata* nearest allied to ruminants. They are called, respectively, *Tapirulus hyracinus*, and *Acotherium saturninum*. The fossils of this bed resemble very closely those of the limestones of Paris.

MASTODON ANGUSTIDENS, AND NORTHERN FOSSIL ELEPHAS.

For several years past, it has been a matter of considerable doubt whether the remains of the *Mastodon angustidens* have ever been found in the United States. The species of mastodon common in Northern America was the *M. giganteus*, while the *M. angustidens* appears to have been confined to the Old World, and according to Darwin to some parts of South America. Dr. John C. Warren of Boston, who, by his researches, has identified his name with that of the

mastodon on this continent, on the evidence of a tooth in the possession of the Philadelphia Academy of Natural Sciences, the history of which he laboriously traced, has decided that this species was a native of North America. The locality of the tooth referred to is a few miles from Baltimore, but its authenticity has been somewhat questioned by some geologists. At the meeting of the American Association at Charleston, Prof. R. W. Gibbes stated, that he had recently procured a fragment of a tooth of the *M. angustidens*, found amid a heap of rubbish used in filling up an old wharf in Baltimore. If it was derived, as is not improbable, from the neighbourhood, it would seem to confirm the conclusions previously arrived at by Dr. Warren.

At the American Association, at Cambridge, in 1849, Prof. Agassiz exhibited the teeth and tusks of a new species of *Elephas* found in Vermont.* Prof. Gibbes stated, that, since this discovery, a tooth of the same species had been found in Duplin Co., N. C. It is therefore settled that this species also occurs in the Southern States.

FOSSIL REMAINS OF THE BIRDS OF NEW ZEALAND.

A SPLENDID collection of the fossil remains of the *Dinornis*, and other birds of New Zealand, has recently been transmitted to England by Walter Mantell, Esq., Government Commissioner of those islands. This collection contains above five hundred specimens referable to various species of *Dinornis* and allied genera; and to species of *albatross*, *penguin*, *water-hen*, and *apteryx*, with portions of egg-shells of three different types. With the above were also associated bones of a species of dog and two species of seal. Some of these bones were imbedded in a morass, which is of small extent and only exposed at low water. This swamp was composed of vegetable fibres, sand, and animal matter; and seems to have been originally a morass in which the New Zealand flax grew luxuriantly. The bones are literally tanned, and so well preserved as to appear as fresh as if recent. Among the specimens are crania and mandibles, and bones of the most colossal size. The most extraordinary relics are the entire series of bones (twenty-six in number) of the feet and shanks of the same individual, *Dinornis robustus*, found standing erect, the one about a yard in advance of the other, as if the bird had been mired, and, being unable to extricate itself, had perished on the spot. They were dug up and carefully numbered seriatim, and are now articulated like a recent skeleton. This is the only known instance of the bones of the foot and tarsus in a natural condition, and consequently the first certain example of the structure of the bones of the feet of the colossal birds of New Zealand. There are no clear indications of this bird having had a hinder toe, as in the smaller species of *Palapteryx*, in which the articulation for a posterior toe is strongly marked. The foot when recent must have been sixteen inches long and eighteen inches wide; the height of the bird to which the bones belonged was about ten feet. Dr. Mantell suggests that these bone deposits, though geologically

* See *Annual of Scientific Discovery*, 1850, p. 286.

modern, are of high antiquity in relation to the human inhabitants of New Zealand, and considers it probable that these stupendous birds formerly ranged over a vast continent, now submerged, and of which the islands of the Pacific are the culminating points. Although there seems to be but little doubt that, like the Dodo and Solitaire of the Mauritius, and the gigantic elk of Ireland, the last of the Moas was exterminated by human agency, yet it is probable that a change in physical conditions had prepared for their final annihilation. Of the organic law which determines the extinction of a race of highly organized beings, and whose effects through innumerable ages paleontology has in part discovered, we are as utterly ignorant as of that which governs the first appearance of the minutest living organisms the powers of the microscope enable us to descry; both are veiled in inscrutable mystery; the results only are within the scope of our finite comprehension. — *Silliman's Journal*, May.

RECENT IMPRESSIONS OF THE FEET OF BIRDS.

Mr. J. L. HAYES stated that Dr. Webster, of Nova Scotia, had lately procured some specimens of recent bird-tracks in the sand of the Bay of Fundy, which were precisely like the fossil bird-tracks of the sandstone of the Connecticut valley. The enormous tides of this Bay wear away the sandstone, and deposit it on the neighbouring beaches to the depth of from half an inch to an inch at each tide. Dr. Webster carefully removed some of this sand bearing the footprints of marsh birds, and baked it so as to preserve the impressions perfectly. It was even found that, in splitting these slabs into layers, the impressions of the track could be traced through three or four of them, as in the fossil specimens. The same success attended his experiments on the impressions of recent rain-drops. Dr. Gould mentioned that he had seen similar specimens from Nova Scotia baked by the heat of the summer sun, during the recess of the tide; and Mr. Lyell also obtained specimens, which were so satisfactory as to convince English geologists that the fossil bird-tracks were really what they had been considered by American geologists. — *Proc. Boston Society of Natural History*, Feb.

ON THE REPTILIAN FOOTPRINTS IN THE CARBONIFEROUS ROCKS OF EASTERN PENNSYLVANIA.

DURING the year 1849, Mr. Isaac Lea, of Philadelphia, announced the discovery of reptilian footprints in rocks which he considered to belong to the old red sandstone, underlying the carboniferous formation of Eastern Pennsylvania.* The strata in which these tracks occur have since been carefully investigated by Prof. H. D. Rogers, who has ascertained that they belong truly to the carboniferous red shale, and are, therefore, of an age essentially later than that attributed to them. In a communication made to the American Association, Prof.

* See *Annual of Scientific Discovery*, 1850, p. 281.

Rogers says,—They occur, indeed, in a geological horizon, only a few hundred feet below the conglomerate which marks the beginning of the productive coal series, in which series similar footprints, attributed to batrachian reptiles, had been previously met with in Western Pennsylvania. Instead, therefore, of constituting a register of the antique life earlier than any hitherto discovered, by at least a whole chapter in the geological book, they carry back its age only by a single leaf. The surfaces upon which these interesting footprints abound are the smooth, divisional plains separating the beds of red sandstone, and are invariably coated with a fine impalpable material of a once slimy and soft mud; and every thing in the texture of these surfaces goes to prove that they were in contact with the air, and were the stages of rest between the alternate depositions of the strata. Many of them are covered with ripple lines and water marks, suggestive of the shelving shore, and, with few exceptions, they are spotted over with little circular impressions, imputed to the pattering of rain. All over the successive floors of this ancient world, as delicate and impressible in their texture as so much wax or parchment, are the footsteps and the trails of various creeping things,—the prints of some unknown four-footed creature, thought to be reptilian in its nature, but of whose true affinities the Professor expressed his doubts, trails analogous to those of worms and mollusks, and various other marks, written in hieroglyphics too ancient to be interpreted. The larger footprints are, for the most part, five-toed, alternate in the steps, and with the fore feet as large nearly as the hind ones; marks of the scratching and slipping of the feet, and the half effacing passage of the tail, or of some soft portion of the body, are often distinctly legible.

Prof. Agassiz stated his doubts as to the reptilian character of the footprints noticed, and, after describing the difference in the arrangement of the locomotive organs of the modern and the ancient fishes, gave it as his belief, that in those early periods there were fishes of a structure which permitted them to walk upon all fours.

ON THE OCCURRENCE OF EXOGENOUS WOOD IN THE LIAS FORMATION.

MR. J. C. SORBY has found, on submitting sections of fossil wood from the lias of Gloucestershire to the microscope, indications of ducts and imperfect spiral vessels. This observation is interesting from the fact that hitherto exogenous wood has not been found so low down as the lias. — *London Athenæum*.

ON THE OCCURRENCE OF PALMS IN THE COAL FORMATION.

AT a late meeting of the Boston Society of Natural History, Mr. Teschemacher exhibited several specimens of palms from the country back of Singapore. The object of the exhibition of these palms was, he said, to show several agreements between them and the vegetation of the coal period, of which he exhibited specimens in the anthracite coal itself. He observed, that in the most recent work on this sub-

ject, three species of palms only are noticed as occurring in the coal. Others have been found in bituminous shales, but the largest part of the fossils, considered as palms, have been found in much later formations. Mr. Tescemacher thought he could show that the palms formed a more considerable portion of the coal vegetation than had been generally supposed. On six or eight specimens of the coal, the vegetable fossils were interspersed with round concavities, from a very small size to a quarter of an inch in diameter, some of them surrounded by stellate fissures, and filled with a black powder; these he had long considered as a fungus growth. On the recent specimens exhibited were precisely the same appearances, so that no doubt could be entertained of the correctness of this opinion. Although the existence of this fungus on the recent palm is no distinct proof of the fossil plant being a palm, as the same fungus may also vegetate upon *Gramineæ*, *Calamiteæ*, or *Filices*, yet, as the fossil stem and its structure resembles that of the palm, this evidence is of some weight. He then exhibited other much larger and more extensive stellate appearances on the fossils, each with its nucleus, which he thought also belonged to the fungus tribe, particularly as in one specimen they were connected together. Specimens of fossil vegetables in coal were exhibited, containing horizontal fissures across the vegetable structure; these which were curved and irregular in various ways, he compared with the veins in the various recent palm-leaves, which are also horizontal, and explained that these veins, being composed of annular vessels, under vertical pressure would form exactly such fissures as are observed in the fossil. The only difficulty attending the explanation was, that some fossil specimens contained these horizontal fissures of such large dimensions, that some of the foliar appendages must have been of much larger size than any now existing; still he thought he could produce other fossil proof of the existence of this enormous foliage. In reply to a question from Prof. Rogers, Mr. Tescemacher said, that under the microscope the coal striæ lose their definite outline, and no organic texture is made out.

BOTANY.

ON THE SUCCESSIVE PERIODS OF VEGETATION OCCUPYING THE SURFACE OF THE EARTH.

WHEN we compare the different forms of plants which have inhabited the surface of the earth at different epochs of its formation, we shall perceive that great differences present themselves in the nature of the vegetables which have been successively developed, and have replaced those destroyed by the revolutions and the changes in the physical condition of its surface. These are not mere specific differences, slight modifications of the same types; but more frequently they are profound differences, in such sort that new genera or families take the place of genera and families destroyed and completely distinct; or a numerous and varied family is reduced to a few species, whilst another, poorly represented by a few individuals, becomes all at once numerous and predominant. This is what strikes us most commonly in passing from one geological formation to another; but in considering these transformations collectively, a more general and more important result presents itself in an unmistakable manner, namely, the predominance in the most ancient times of Acrogenous Cryptogamic plants (Ferns and Lycopodiaceæ); later, the predominance of Gymnospermous Dicotyledons (Cycadææ and Coniferæ), without the admixture yet of a single Angiospermous Dicotyledon; finally, during the cretaceous formation, the appearance, and soon the predominance, of Angiospermous plants, both Dicotyledons and Monocotyledons. These very remarkable differences in the composition of the vegetation of the earth show that we may divide the long series of ages which have presided over this successive birth of the different forms of the vegetable kingdom into three long periods, which I shall denominate the reign of the Acrogens, that of the Gymnosperms, and that of the Angiosperms. These expressions merely indicate the successive predominance of each of these three great divisions of the vegetable kingdom, and not the entire exclusion of the others; thus in the two first, the Acrogens and the Gymnosperms exist simultaneously, only the former prevail at first over the latter in number and in

size, while in the latter period the converse holds. But during these two reigns, Angiospermous plants appear to be wholly absent, or are announced by a few rare signs, doubtful and very different from existing forms. Each of these three reigns, thus characterized by the predominance of one of the great divisions of the vegetable kingdom, is commonly subdivided into several periods, during which forms very analogous, belonging to the same families and often to the same genera, are perpetuated; then these periods themselves comprise several epochs during which vegetation does not appear to have undergone any notable changes. But in many cases we are still without materials for establishing these last subdivisions with precision, either from the fact that the exact geological position of the strata which inclose the impressions of the plants is not well determined, or that the mode of distribution of the species of plants in the different layers of the same formation has not been carefully made out. In accordance with the knowledge we at present possess, I think that the three following general divisions of the vegetable kingdom may be admitted, each divisible into epochs, during which vegetation preserved its invariable characters: — 1st Division. Reign of the Acrogens, embracing the Carboniferous Period, not divisible into distinct epochs, and the Permian Period, forming but one epoch. 2. Reign of the Gymnosperms, embracing the Vogesian Period, constituting one epoch, and the Jurassic Period, with four epochs, the Keupric, Liassic, Oolitic, and Wealden. 3. Reign of the Angiosperms, embracing the Cretaceous Period, with three epochs, the Subcretaceous, Cretaceous, and Fucoidian; and the Tertiary Period, with three epochs, the Eocene, Miocene, and Pliocene. — *M. Brongniart, in Annales des Sciences Naturelles*, Vol. XI. p. 285; and *Magazine of Natural History*, August and September.

ANALOGY BETWEEN ALPINE AND ARCTIC VEGETATION.

THERE is no animal and no plant, which, in its natural state, is found in every part of the world, but each has assigned to it a situation corresponding with its organization and character. The cod, the trout, and the sturgeon are found only in the North, and have no Antarctic representatives. The cactus is found only in America, and almost exclusively in the tropical parts. Humboldt, to whom the earliest investigations on this subject are due, extends the principle not only to the distribution of plants according to latitude, but also according to vertical elevation above the surface of the earth in the same latitudes. Thus an elevation of 14,000 feet under the tropics corresponds to 53° N. Lat. in America, and 68° in Europe. The vegetation on the summit of Mt. Etna would correspond with that of Mt. Washington, and this again with the summits of the Andes, and the level of the sea in the Arctic regions. In the ascent of a high mountain, we have, as it were, a vertical section of the strata of vegetation which "crop out," or successively appear as we advance towards the north over a wide extent of country. But in dwelling on the resemblances between the plants of high latitudes and those of high moun-

tains, we must not lose sight of their no less constant differences. In the northern regions, in general, we find the number of species comparatively small. Thus, in the region near Lake Superior, which has a northern character, we find vegetation characterized by great vigor; the whole country covered with trees and shrubs, and lichens and mosses in great profusion, but the species few, and the number of handsome flowering shrubs small. In the Alps, on the other hand, vegetation is characterized by great beauty and variety, and the number of brilliantly flowering plants is very great. The plants, however, are dwarfish, and vegetation comparatively scanty, and lichens and mosses much less abundant. There is, then, not an identity, but an analogy only, and an imperfect though very interesting one, between Alpine and Arctic vegetation. — *Agassiz on Lake Superior*, p. 89.

NEW VARIETY OF THE SUGAR-CANE.

A NEW variety of the sugar-cane, called the "crystalline," has within a comparatively recent period been introduced into Louisiana, and is said to be superior to any of the varieties now grown in this country. It is a very large cane, with a tough rind, and remarkably large and firm eyes, indicating a capacity to withstand frosts. It is said, also, to be very juicy and extremely productive. Specimens grown at the parish of Plaquemines, near New Orleans, flourish well, and seem adapted to the climate. If what is said of the crystalline cane be true, its introduction into the sugar districts cannot fail to be of great benefit to the planters, as the complaints concerning the degeneracy of the cane have within the last few years become of very frequent, general, and alarming occurrence. The principal causes, however, of this state of things, says the *New Orleans Picayune*, are imperfect seed and the mode of planting. The kinds of cane cultivated in Louisiana are five, the Bourbon, the red-ribbon, the green-ribbon, the Creole, and the crystalline. The two former are most extensively planted. The crystalline cane, which appears to be the same as the Salangore, or chalk-cane, originated in the South Seas, was imported into the East Indies by the English government, and thence distributed over Jamaica and Cuba. In both the East and West Indies it has given unbounded satisfaction, and will doubtless do the same in this country, where it has not heretofore been tried.

NEW VARIETY OF COTTON.

A NEW kind of cotton has been introduced into Tennessee called the "golden boll." It is a native of Central America. The following description is given of it:—The average height of the stalks is about 4½ feet, planted about 4 feet apart. The distinguishing properties which characterize it are its prolific production, the long, silky texture of its fibre, and the astonishingly large size and great number of bolls. Several of the plants had from 120 to 130 bolls, of which from 60 to 80 were fully matured; 10 of which being frequently tested by scales weighed 4½ ounces of seed-cotton. The bolls that did

not reach full maturity of size all opened, yielding cotton of apparently as good quality, but not of the same amount, as the earlier bolls. The bolls open freely, and the cotton adheres well to the boll, which renders it less liable to be beaten out by the weather than ordinary cotton. The limbs, from which—and not from the joints or forks, as in other cotton—the stem of the bolls shoots, being short, the plant can be more closely cultivated than any other. It is thought that four plants of this species can be accommodated on the space ordinarily occupied by two. The plant is hardy, and produces a short staple cotton of remarkable fineness. — *De Bow's Commercial Review*, Jan.

THE GAMBOGE TREE.

DR. CHRISTISON has communicated to the Royal Society of Edinburgh a paper on the "gamboge tree of Siam." He states that, although gamboge has been known in European commerce for nearly two centuries and a half, the tree which produces it is still unknown to botanists. Since 1836 three species of *Gercinia* have been described, respectively found in Ceylon, Western Mysore and Birmah, and in Northeastern Bengal, and all producing varieties of gamboge differing slightly in chemical composition from each other and from that of Siam. Recent information renders it probable that some specimens taken from two trees cultivated at Singapore by Dr. Almeida, and by him stated to have been obtained "direct from Siam," do in reality belong to the gamboge tree of that country. The specimens do not allow of a complete description, but, in common with the species previously described, the fruit is round, not grooved, crowned by a four-lobed knotty stigma, and surrounded by numerous sessile or subsessile aborted anthers, and by a persistent calyx of four ventricose fleshy sepals. It differs from the previously known species in having all the male flowers and fruit peduncled, and in other respects, so that there can be no doubt of its being a distinct species. Measures have been taken to procure further information concerning it.

TRANSPLANTING OF EVERGREENS.

An interesting paper on the best season of the year in which to transplant evergreens, furnished by Mr. Glendinning, has been published in the fourth volume of the *Journal of the Horticultural Society*, in London. In opposition to the opinion and practice of many persons, Mr. Glendinning prefers the month of August to any other, and facts would seem to substantiate the correctness of his opinion. He says, — "It would be travelling over a beaten track to enter into any general detail respecting the ascent and descent of the fluids in plants, and the formation and deposition annually of new wood in all ligneous vegetation. It will be sufficient for my purpose to state that this extension and formation takes place chiefly after midsummer, and principally in evergreens during autumn, when the young shoots begin to attain a certain degree of consistency. It is during this downward

tendency of the fluids, and when the solar action is in some measure on the decline, that I should conduct with all rapidity the operations of transplanting; and, if this is intended to be conducted extensively, I should recommend the end of August as a good time to begin, September being the *safest* month in the year; selecting such plants to commence with as have matured their shoots. Another and very important reason remains to be stated, why autumn is to be preferred for undertakings of this kind in preference to winter. The force of the sun during summer, although now on the decline, has warmed the earth to a considerable degree and depth, so that the mutilated roots are comparatively situated on a gentle bottom-heat, which rapidly promotes cicatrization, and frequently aids the emission of young spongellets during the current autumn. That the season which I have here ventured to urge for the performance of the work under consideration is undeniably theoretically the right period, appears beyond all question; and I can attest also that it is practically the season to be preferred beyond all others. I had occasion to superintend the removal of upwards of 2,000 trees and shrubs, all evergreen, and varying in size from 6 to 40 feet high, during one autumn. The trees were prepared as formerly described the previous spring, and as the undertaking was rather gigantic, the work was begun in August and finished with the year. The result was of course watched with some interest, and the following summer, when an examination took place, I found that those trees which were transplanted early in the season indicated little change from their removal, but the contrary was the case with those which had undergone a similar transplanting during December."

WOORARA POISON.

At the meeting of the French Academy on Oct. 14, M. Bernard presented a paper describing some experiments performed by M. Pelouze and himself on the woorara poison, prepared by the tribes inhabiting the districts of Upper Orinoco, Rio Negro, and the Amazon. The woorara is a watery extract prepared from a plant of the Strychnos family, and acts instantaneously when introduced into the blood-vessels. A weak solution injected into the jugular veins of dogs caused sudden death, without producing cries or convulsive movements in the animal. When introduced into a wound beneath the skin, the poison acts more slowly, varying with the dose and the size or species of animal. *Cæteris paribus*, birds die most speedily, then Mammiferæ, then reptiles. In every case, the signs of poisoning are similar; the animal moves about as usual for a brief interval, and then lies down and dies without a struggle. Immediately after death the nerves of the animals are as inert and insensible to stimulation as if they had been long dead. The blood is black, and does not readily coagulate nor redden on exposure to the air. The poisonous effects of woorara present a close analogy with those of a viper's bite, and, like that venom, it is innocuous when taken into the digestive tube. That its properties are not then destroyed by digestion was shown by the experiment of inserting some gastric juice into a wound forty

eight hours after the poison had been taken into the stomach; when the usual poisonous effects were manifested. This fact is explained by the discovery that the woorara is not absorbed from the alimentary mucous membrane. So long as the mucous membrane retains its integrity, the woorara solution does not pass through the endosmometer. Other mucous membranes present the same result, the pulmonary one being the only exception. A few drops of the solution introduced into the air passages produce the same morbid effects, and the same rapidity of death ensues as if it had been inserted beneath the skin.

THE UPAS TREE.

A CORRESPONDENT of the *New York Post*, writing from Borneo, gives the following account of the upas tree:—Below Bruni is a real upas tree; it is spoken of in Keppel's work. It is a magnificent tree, about two feet or more in diameter, and rising sixty feet without a branch; there it spreads with a dense green foliage. The trunk is smooth, and of a dirty silvery color. Upon wounding it, a milky secretion exudes rapidly. This is mixed with other juices, and used as a poison for arrows. Except when taken internally, or thrown into the circulation through a wound, I believe it is perfectly harmless. I tried to get enough for a cane, but could not. The only way we obtained the leaves was by shooting our guns into the lofty branches.

FLORA OF THE DATE COUNTRY AND SAHARA.

M. D'ESCEYRAC DE LAUTURE has announced to the French Academy his return from a journey to the date country and Sahara, with a collection of about two hundred species of plants, forming the peculiar flora of the Great Desert, and of the region of the oases. Besides the male date, *Dokkar*, M. d'Esceyrac has determined about thirty principal varieties of the date tree, among which he particularly mentions the *Menakher*, which yields fruit the length of the finger, which is very rare and of high price; the *Degle*, the tallest and most majestic, whose fruit is commonly brought to Europe, and is eaten in the country by the wealthy classes; the *Halig*, which yields food to the poor; and, lastly, the *Amméri* and *Saroti*, whose flowers are rarely fruitful.—*L'Institut*, No. 821.

MARINE FLORA OF THE ATLANTIC STATES.

At the American Association, Charleston, S. C., Prof. Harvey, of Dublin, stated that there exists a greater degree of similarity in the marine Flora of the two sides of the Atlantic than in their marine Fauna, from the facility with which the spores of the Algæ may be transported to a great distance by natural agencies. But, from the rise of the isothermal lines on the European side, the species of low latitudes in America are similar to those of higher latitudes in Europe; those of Key West, for instance, in lat. 24°, are similar to those of the Mediterranean. It is not yet possible to mark out with

precision the geographical distribution of Algæ along the coast, but differences may be perceived in the marine Flora of the region north of Cape Cod, that of Long Island Sound, that of Charleston Harbour, and that of Key West.

CALIFORNIA SOAP-PLANT.

THE soap-plant, so called, grows all over California, on high hills as well as in the valleys. The leaves make their appearance about the middle of November, or about six weeks after the rainy season has fairly set in; the plants never grow more than one foot high, and the leaves and stalk drop entirely off in May, though the bulbs remain in the ground all summer without decaying. It is used to wash with in all parts of the country, and by those who know its virtues it is preferred to the best of soap. The method of using it is merely to strip off the husk, dip the clothes in water, and rub the bulb on them; it makes a thick lather, and smells not unlike new brown soap. The botanical name of the plant is *Phalangium pomaridianum*. Besides this plant, the bark of a tree, *Chelaria saponaria*, is also used in South America for the purposes of washing. Several other plants have been used in various countries as a substitute for soap. All of these contain considerable quantities of oleaginous and alkaline principles in their composition, on which their value depends. — *Proceedings of the Boston Society of Natural History*.

COFFEE.

THE principal species of coffee are the Mocha, or Turkey coffee, Jamaica, St. Domingo, Cuba, Porto Rico, Demerara, Bourbon, Martinico, and Hayti. All species of coffee improve by keeping; it is in the best condition when two or three years old. Good coffee should not have the slightest odor of mouldiness, or any other odor, for the berries of coffee absorb most readily the effluvia from other bodies, and thus acquire an unpleasant flavor. Many cargoes have been spoiled from having been shipped with, or even put into, vessels which had previously been freighted with sugar. A few bags of pepper are sufficient to spoil a whole shipload of coffee. Coffee, even that of the very best quality, and in the best condition, may be impaired by improper roasting, which operation is one of some nicety, and seldom well performed. If roasted too little, the aroma will not be fully developed, and the best coffee may then yield a vapid and effete infusion of an unripe flavor; if roasted too much, the aroma is dissipated, and the infusion will have a bitter, flat taste. After having been roasted to the proper degree, it should be emptied whilst hot into wooden boxes, furnished with sound, well-fitting covers, and it should be kept therein until cold, and not cooled in the open air. If roasted in small quantities, it may be emptied into a sheet of brown paper, and the whole wrapped up in flannel until cold. Roasted coffee should be preserved in well-closed and perfectly dry vessels. The berries when properly roasted are of a full and rich brown color,

bright and oily superficially. No article is probably adulterated to a greater extent than ground coffee. And it is always better for the consumer to have his coffee ground at home, rather than run the risk of drinking an infusion of chickory, ground beans and peas, ochre, brick-dust, &c. Ground coffee in addition, even if genuine, soon loses its aroma by keeping.

VALUE OF THE ARTICHOKE AS AN AGRICULTURAL PRODUCT.

RECENT investigations of this common root show that 100 parts by weight of the tubers contain 23.96 of alimentary substance, being richer in nitrogenous, fatty, and saccharine matters, and in phosphates, than potatoes. It therefore follows that the artichoke would prove most valuable for the fattening of pigs, cows, and animals generally, and its cultivation for this purpose is well worth the attention of farmers. As the tubers do not contain amylaceous substances, and are very easily soluble and digestible, it would be best to mix them with other aliments more resistant and less humid; such, for example, as dry fodder, bran, and grains, which would be ameliorated by the mixture. As to the difficulty of limiting their spontaneous reproduction, that may be prevented by the cultivation within boundaries, especially of plants which are cut down in the green, making weeded or hoed plants succeed them. The stems of the young artichokes also constitute a good green fodder. — *Proceedings of the National French Agricultural Society.*

ATMOSPHERIC DISSEMINATION OF ALGOUS PLANTS.

THE following observations on the atmospheric dissemination of algaous plants were made, by Dr. Burnett, at a meeting of the Boston Society of Natural History, in July: — "The occurrence of minute algæ and spores in liquids and infusions, under circumstances rendering it improbable that they could have been introduced from without, is a fact constantly falling under the eye of the microscopical observer. These facts, viewed in different relations, have served in some hands as arguments for the doctrine of equivocal generation; and in others as the groundwork for theories as to the true cause of miasmatic diseases. While making some experiments upon diabetic urine (the abundant presence in which of the common ferment alga, *Torula cerevisia*, is well known), I was surprised to find all the common liquids in its neighbourhood pervaded by the same alga, and particularly those exhibiting any tendency to decomposition. This led me to think that the dissemination of this minute plant took place by the medium of the atmosphere, which was full of its spores. Some experiments with air-tight and partially covered vessels of liquid, placed near the original source, showed this to be true. And even now, several weeks after its occurrence, the atmosphere of the room seems to have retained many of the spores; for liquids placed as before soon contain many of the plants. I state this fact, because I think an undue share of importance has been attached to the presence of fungi

and algæ in various localities, and especially as their being *the cause* of various coincident phenomena; whereas, viewed in another light, their presence may, in most instances, be considered accidental, in the ordinary acceptance of the word."

Dr. C. T. Jackson alluded to experiments made of passing the air containing these fungi through concentrated sulphuric acid; no infusoria were found in vessels to which air could only gain admittance to a vegetable infusion through this medium, while they were abundantly found in infusions to which air had free access. These results confirmed Dr. B.'s statements.

OBSERVATIONS ON THE GROWTH OF PLANTS IN ABNORMAL ATMOSPHERES.

As oxygen is the most important constituent of the atmosphere, so far as animal life is concerned, so it is on the carbonic acid, ammonia, and aqueous vapor that the vegetable world is eminently dependent. Do the oxygen and nitrogen of the air play no important part in the process of vegetation? The following experiments, with a view of settling this and similar inquiries, have been published by the Messrs. Gladstone:—A pansy lived for 24 days in an atmosphere of hydrogen, containing 5 per cent. of carbonic acid; one similarly placed in an atmosphere of common air remained healthy for a longer period. Five onions just commencing to sprout were severally placed in carbonic acid, carbonic oxide, coal gas, air containing 8 per cent. of light carburetted hydrogen, and ordinary atmospheric air. The germination in the first two was entirely stopped; while the hydrocarbons appeared to considerably accelerate the growth of the vegetable. The plants in each case lost weight. A pansy in flower, a young stock, and a grass plant were placed in pure nitrogen gas. The first two soon died, but the grass was left growing a month after the commencement of the experiment. Another pansy was placed in a mixture of hydrogen and oxygen gases, in the proportion requisite to form water. In order to imitate the balance which exists in nature between animal and vegetable life, some flies were introduced, along with some sugar to serve as their food. No change for the space of two weeks was observed in this plant. Owing to the light specific gravity of the mixed gases, the flies were unable to mount on the wing, or make the usual buzzing noise; but the substitution of hydrogen for nitrogen in the atmosphere had no marked effect upon their breathing, thus confirming the observations of Reynault by an instance drawn from Articulata.—*London Chemist, Oct.*

At the British Association, Mr. Daubeny stated, that he had ferns growing in an atmosphere containing one per cent. of carbonic acid in excess above that ordinarily contained in air, and although it was thought similar ferns growing under the same conditions, but without carbonic acid in excess, were the most luxuriant, it appeared that they thrived well in this atmosphere. Ferns supplied with water containing one per cent. of carbonic acid grew much more luxuriously than those which were supplied with pure water, so that the conclusion

might be come to, that, although very large quantities of carbonic acid were injurious to plants, yet that when present in water from one to five per cent. it was beneficial.

CAUSE OF THE POTATO DISEASE.

THE precise cause of the potato disease is still unknown; but we are able at least to eliminate certain presumed causes, and to prove where the disease begins, and how it reaches the tubers. It is pretty generally admitted at present, that the parts of the plant exposed to the air are first attacked, and that their diseased state precedes that of the tubers, and probably causes it. The following is a rather curious proof that such is the case. M. Gheldere, of Belgium, grafted some tobacco plants upon potatoes. Success was probable, as the *Nicotina* and *Solanum* belong to the same family. The grafts did not merely take, a fact of itself very interesting, but the plants happening to be in a field of potatoes entirely attacked by the disease, the grafted stocks alone remained exempt. If the tubers were sound in this case, it can only be attributed to the presence of the leaves of tobacco not liable to the disease, instead of the leaves of the potato itself. This fact is recorded in the report on the exhibition of the products of Belgian agriculture and horticulture. — *Bibliothèque Universelle*, Feb.

At a meeting of the Boston Society of Natural History in August, Dr. Burnet called attention to a disease which had been noticed by *dealers*, in the sweet potato. When the rot once became introduced into a barrel of these potatoes, it would always go through the whole. Examinations showed that this disease was a peculiar kind of fungus, similar, though not identical, with that in the common potato. The fact of its spreading through the barrel would argue that it was contagious. Dr. Burnet did not attribute the disease to insects, but to some chemical change in the cellular structure of the plant.

PRESERVATION OF WHEAT FROM THE ATTACKS OF THE WEEVIL.

NUMEROUS remedies have been proposed to protect wheat from the destructive ravages of the weevil, but most of them have been impracticable or too expensive. M. Caillat, in the *Comptes Rendus*, recommends the use of tar as a certain and economical agent for their destruction. He says, "the efficacy of tar in driving away the weevil and preserving the grain is an incontestable fact. My father had, a long time ago, his granaries, barns, and the whole house, infested with these insects, so much so that they penetrated into all the chests, and among the linen. He placed an open cask impregnated with tar in the barn, and then in the granaries; at the end of some hours the weevils were seen climbing along the walls by myriads, and flying in all directions away from the cask. On moving this tarred vessel from place to place, the premises were in a few days completely cleared of these troublesome and pernicious guests. The agriculturalist who wants to get rid of weevils, may, as soon as he perceives their presence, impregnate the surface of some old planks with tar, and place

them as required in his granaries. Care must be taken to renew the tar from time to time in the course of the year, to prevent the return of the insects."

MODE OF PRESERVING PLANTS AND FLOWERS.

A COMMITTEE appointed by the French Academy to examine a communication of M. Gannal concerning "the preparation of plants for herbariums, so as to preserve almost without change the color of the flowers and leaves," made their report on Dec. 24, 1849. After referring to the present imperfect mode of preserving flowers, they observe that the essential condition in preparing plants is to dry them as rapidly as possible, for if life remains in them for a few days the color is lost, and other changes take place. An apparatus invented by M. Gannal, which receives the approbation of the committee, dries the most difficult plants in twenty-four hours. This process consists in placing the plants in the leaves of gray paper, which absorb immediately the moisture arising from rain or dew, so that they remain unchanged for twenty-four hours. The next day they are placed in very dry paper, after which they are put into the apparatus we are about to describe, by which they are completely dried in twenty-four hours. The principle of M. Gannal's method is, that the moisture under ordinary circumstances evaporates very slowly, but by increasing the temperature and lessening the atmospheric pressure it disappears much more rapidly. To effect this he takes a cylindrical copper vessel, large enough to contain readily a parcel of one hundred specimens, which he places in it, and into the empty space at the sides puts about four kilogrammes of quicklime, after which the cover is fastened. Having been placed in a little basin, the apparatus is brought to a temperature of 50° or 60° (Centigrade?) by means of boiling water turned into the basin, after which a vacuum is created by a pneumatic pump fastened to a cock in the cover. After creating the vacuum by pumping at intervals for two or three hours, the plants are allowed to remain from twenty-four to thirty hours, and are then perfectly preserved, with all their natural colors and appearances.

CHINESE BOTANICAL MEDICINE.

M. DE PARAVEY drew attention to a substance well known in Chinese medicine, which is called *ou-poey-tse*. It appears to be a sort of gall, possessing a very remarkable astringent power. It develops itself as an excrescence upon a variety of ash, and is used by the Chinese with great success in cases of diarrhœa.—*Comptes Rendus*, Feb. 4.

ZOÖLOGY.

ZOÖLOGY OF GUATEMALA.

M. MORELLET states that his explorations of portions of Guatemala have furnished him with two new species of Coniferæ, a considerable number of new Echinoderms, Crustaceans, &c., one hundred and seventy-eight species of insects, of which at least one half are undescribed, nearly one hundred and fifty undescribed species of mollusks, a new genus and fourteen new species of fishes, besides twelve at present uncertain, six new species of reptiles, and five doubtful, and two new species of birds, besides many other rare specimens, both botanical and zoölogical. — *Comptes Rendus*, Feb. 25.

ON THE FORAMINIFERÆ OF THE COAST OF THE UNITED STATES.

AT the American Association, Charleston, M. Pourtales presented a communication respecting the existence of foraminiferæ on the coast of the United States, as indicated by the materials brought up in the soundings made in the progress of the coast survey. The whole number of specimens obtained from the region embraced between the 38th and 40th degrees of latitude, and between the shore and the farthest point they reach, which is about the 100 fathom curve, was near 1,200. The distribution of foraminiferæ, the most abundant of the organisms found in deep-sea soundings, has been found to depend, as far as this region is concerned, altogether upon the depth at which they are collected. Beginning at the shore, we find a region almost entirely bare of foraminiferæ. This region extends to the depth of about 15 fathoms. The bottom is mostly composed of a quartzose sand exposed to the motion of the water, and consequently not well adapted as a habitation for so delicate animals. Beyond this depth the foraminiferæ become abundant, both in species and individuals. At the depth of about 60 fathoms we find one species, the *Globigerina rubra*, becoming extremely preponderant in number, and its abundance seems to increase with the depth. The greatest depth from which specimens have been examined is 267 fathoms, and there the *Globigerina* is still living in

immense numbers; sometimes their number seems almost to equal the grains of sand. The bottom in this region is of a fine gray sand. We may distinguish three regions characterized by foraminiferæ; the first near the shore, without any, extends to about 15 fathoms; the second goes to about 60 fathoms, and is characterized by a great number of species, of which the *Rotulina Baileyi* seems to be most numerous represented; at about 60 fathoms the *Globigerina* preponderates, the *Rotulina* disappearing, and this region extends to a depth not yet known.

M. Pourtales has also pointed out, for the first time, a direct and well sustained analogy which is to be found in the order of the succession of the cells of foraminiferæ of several genera, and the succession of leaves in plants; so fully, that it can be expressed by the same fractions with which botanists are in the habit of expressing phyllotaxis in the vegetable kingdom. This is, therefore, an important additional link in the investigation of the plan which regulates the normal position of parts in organized beings, a link which may lead us to include in one universal formula the rhythmic movements which preside over the development of all finite beings, as the phyllotactic formulæ themselves are now known to express also the natural relations which exist in the movements of the bodies belonging to our solar system. — *Proceedings of the American Association.*

INFUSORIA OF THE DEAD SEA AND THE RIVER JORDAN.

EHRENBERG has lately examined specimens of the water and sediment of the Dead Sea and the River Jordan in a zoölogical point of view, and finds in the former an abundance of Infusoria, nearly all of which are of fresh or brackish water species, indicating that this lake never formed any part of the general ocean. The waters of the Jordan also abound in Infusoria, all of the fresh-water kinds, a fact rendering it probable that great rivers, like basins of the ocean, have their peculiar and characteristic species. — *Jameson's Philosophical Journal*, Jan.

AMERICAN FRESH-WATER MOLLUSKS.

AT a meeting of the Boston Society of Natural History, in November, Prof. Agassiz stated that he had been of late engaged in the study of the soft parts of American fresh-water mollusks, and their relations to the shell, with the object, if possible, of discovering some new characters on which to base an accurate classification. He had found that, in addition to the two muscular impressions in the shell usually described, there are generally two or more impressions produced by muscular fibres springing from the foot, which impressions in some species are confluent, in others more or less distinct. Other distinctive characters are observed in the arrangement of the mantle. In some of the Naiades, the posterior portion of the gills only is found to be distended with eggs at the breeding season, in others the whole gill is so distended. In the former of these, Prof. Agassiz had found the cavity containing the eggs to be limited at each end by transverse

bridges, beyond which the folds of the gills are closely adherent to each other, and at this season the outer gill is longer than the inner in both sexes. Other characters are furnished by the gills, according as they are attached to the foot or the transverse muscles. Prof. Agassiz said that he had been led by these observations to a division of the Naiades into natural genera, from the structure of the animal, as well as shell, which had not been so well done hitherto from the shell alone. He proposed to include under one genus, *Unio alatus*, *U. fragilis*, *U. gracilis*, *U. Ohioensis*, *U. leptodon*, *U. Sayii*, *U. compressus*, and *U. rectus*. Of *Unio alatus* he remarked that specimens from the Western waters, and from Lake Champlain, present differences in the teeth on the hinge, and in the general configuration of the shell, but not, in his opinion, enough to make a difference of species. *U. gracilis* and *U. fragilis*, by some considered separate species, are only distinguished by similar differences. To another genus, Prof. Agassiz proposed to refer *U. flexus* and *gibbosus*, from characters based on the more or less circumscribed disposition of the essential internal organs. In conclusion, Prof. Agassiz said that the fact that the Unios are perfect at the time of birth, although very small and of extreme delicacy, led to interesting speculations, how it could have been possible for so widely extended a family to have been distributed by any influence not primitive.

WEIGHT OF SHELLS AND THEIR DISTRIBUTION AS REGARDS SIZE.

In his *Contributions to Conchology*, No. 4, Prof. C. B. Adams gives a table showing the weight of shells of certain species of *Colimacea*. Several shells were weighed at a time in accurate balances, and the only error possible arises from the fact, that in the very small species the animals are usually dried up in the shells. Those shells having the smallest weights are *Pupa Jamaicensis*, .003 grain; *Achatina iota*, .0025; *Helix apex*, .0039; *Stoastoma Blandianum*, *Bulimus minimus*, and *Pupa milium*, each of which weigh only .004 grain; and *Pupa minutissima*, only .00467. *Truncatella fusca* weighs .00667 grain; *Stoastoma Redfieldianum*, .0078. The other shells, of which forty-six species are given, vary from this up to about 2 grains, though one weighs as much as 71.41 grains; by far the larger portion weigh considerably less than a grain each.

Pupa minutissima is the least of the European land shells with which we are acquainted, and *P. milium* is the least of the species which inhabit the United States. Three of the species of the land shells of Jamaica, *Helix apex*, *Pupa Jamaicensis*, and *Achatina iota*, are, it will be seen, smaller than either of these, the latter being probably the least of all the known species of terrestrial mollusks. It follows that the least of all known terrestrial shells exist in tropical regions. An investigation of the marine shells collected in Jamaica also shows a large number of extremely minute shells. From the fact that the larger species occur only in tropical regions, it has been too hastily inferred that only temperate regions contain a large portion of very small species. The difference of zones is not that one ex-

treme of size is found in the tropics, and the other in temperate climates, but that, while both appear in tropical countries, one extreme is deficient in temperate regions. Within the tropics, however, there appears to be a great difference in the average size of the land shells of different regions. In the West Indies and the Polynesian Islands, there is a great proportion of small species. But in Brazil and the Philippine Islands, there are very few small land shells. It is remarkable that this purely geographical difference greatly exceeds the average difference in the species of different zones.

CALIFORNIA PEARL FISHERIES.

THE pearl fisheries on the western coast of Central America are at present principally conducted by divers and vessels from Acapulco and Mazatlan. The shell-fish producing the pearl, well known to be of the genus *Mya*, species *margaritifera*, occurs abundantly in the Gulf of California, adjoining both American and Mexican territory. The pearls are of excellent water, or lucidness, but generally irregular in form. The vessels employed in the fishery are from 15 to 30 tons burden, and generally owned by individual adventurers, and commanded by them. There is on board of each ship a working crew of sailors and an equal number of Indian divers, technically called *Busos*. With meagre supplies, these vessels sail for the fishing-ground and at once commence business. The *Busos*, armed with pointed staves, plunge into water four or five fathoms deep, and when they find a pearl-bearing oyster, rise to the surface and deposit their prize in a sack hung to the vessel's side. This they continue to do until exhausted, or their time of labor is over. When this is the case, all collect around the owner or *armador*, who divides the gains in the following proportion, viz. two for the government, two for himself, and one for the *Buso*. The share of the *Buso* is generally taken by the *armador*, who contrives to keep in his debt for extra allowances, outfit, etc., all his crew. Often when a *Buso* arrives at the surface of the water, the largest oyster he has taken is laid aside for use of the Virgin, and the simple-minded Indian rarely objects to this pious swindle. In 1831, one vessel with seventy *Busos*, another with fifty, two with thirty, and two with ten each, sailed from the coast of Sonora; one of these brought home in two months forty ounces of pearls, worth \$6,000; another, twenty-one ounces, worth \$3,000, and the rest proportionate quantities. Thus far, no attempts have been made by the Americans to prosecute the pearl fishery, yet we doubt not that, at no distant day, it will become an important and lucrative branch of industry.

REPORT ON ZOÖPHYTES.

Silliman's Journal for March, in a notice of Dana's "Report on Zoöphytes," states that the number of species of corals collected by the Exploring Expedition was so large that it became necessary to revise this department of science throughout, so that the volume in-

cludes all known species of existing coral zoöphytes. Out of the 444 known species (excluding the Alcyonaria), 233 are new species, first described by the author, and of the remaining 211, 122 are redescribed from specimens. To the genus *Madrepora*, previously numbering 20 species, 52 new species are added, and 12 of the old ones redescribed. The 30 known species of *Astrææ* are increased to 62; the 4 of *Euphyliæ*, D., to 15; the 17 *Fungidæ* to 60; the 57 *Madreporidæ* to 141, and 34 of the old species are redescribed. An examination of the animals made it in general possible to give the descriptions a zoölogical character, so that the science is at last rescued from being a mere systematical arrangement of animal secretions. Species hardly distinguishable in the corals were found very different in the animals, and by this means those erroneously referred have been properly classed.

NEW SPECIES OF AMERICAN MEDUSA.

At a meeting of the Boston Society of Natural History, Prof. Agassiz gave a description of a new Naked-eyed Medusa, belonging to a new genus, which he would call *Rhacostoma Atlanticum*. Instead of the usual structure in these animals of four chymiferous tubes reaching a peripheral vessel, with eight or ten tentacles, there are in this animal over 100 appendages to the mouth, and 500 or 600 on the circumference. The mouth is so wide that it has been supposed to be wanting; the union of the appendages to the mouth in a firm cord forms an alimentary cavity for the animal; these are formed of very large polygonal cells, which give a remarkable power of enlarging and contracting this cavity. This is the largest of the family. The circular tube of the margin is a nervous cord; at night it emitted light, and when stimulated the whole outline of the nervous system was seen as an illuminated diagram of a golden-yellow color; so that in this animal, at least, the phosphorescence took place in the substance of the nervous cord. The characteristics of the animal are the extraordinary number of the tubes radiating from the central cavity, and its remarkable power of enlarging and contracting.

MUSCULAR STRUCTURE OF MEDUSÆ.

Prof. Agassiz in a recent study of the Medusæ has been able to make out a distinct muscular structure. It consists of three systems of fibres, one superficial, which has never before been observed, just under the epidermis, the others more deeply seated. The external layer is made up of circular and vertical bands of fibres, surrounding the whole mass like the net of a balloon, and capable by their contraction of changing its shape and reducing its size. The vertical bundles alternating with the radiating tubes are by far the strongest. The fibres upon the inner surface of the disk are disposed in two layers, one of circular, and the other of vertical fibres. The former lines the cavity, the latter is situated between the circulating tubes. By the contraction of these last, the eye-specks can be moved. In the

transverse partition of the animal, a circular and radiating set of muscular fibres can be made out, the latter assisting in moving the eye-specks. Prof. Agassiz has also completed the study of the *nervous* system in *Medusæ*. He has found a continuous nervous thread extending from one eye-speck to another. These organs present a closer analogy to the organs of vision in the higher animals than has been generally supposed. In their structure, some of them united in clusters closely resemble a vertical section of the compound eyes of insects, and probably are capable of receiving an impression of light and darkness, if not of distinct images. Prof. Agassiz's observations of the muscular system of *Medusæ* were made on them when in a state of contraction immediately after death. During life the movements are too active to permit close examination. — *Proceedings of the Boston Natural History Society, Jan.*

ANALOGY BETWEEN THE MODES OF REPRODUCTION IN PLANTS,
AND THE ALTERNATION OF GENERATION OBSERVED IN SOME
RADIATA.

THE very remarkable fact, that a Polyp and a Medusa may be in some instances different states of one and the same species, has been well established of late by the researches of Sars, Dalyell, Steenstrup and others; and recent observations have been made on the subject by Professor Agassiz. The alternations are as follows:—

1. The Medusa produces eggs. 2. The eggs, after passing through an infusorial state, fix themselves and become Polyps, like *Corynæ*, *Tubulariæ*, or *Campanulariæ*. 3. The Polyp produces a kind of bud, that finally drops off and becomes a Medusa. Thus the egg of a Medusa in such cases does not produce a Medusa, except after going through the intermediate state of a Polyp. Or if we commence with the Polyp, the series is,—1. The Polyp produces bulbs that become *Medusæ*. 2. The Medusa produces eggs. 3. The eggs produce Polyps.

This is what is called by Steenstrup “alternation of generations,” and he considers the earlier generation as preparing the way for the later. It certainly seems a most mysterious process,—a parent producing eggs which afford a progeny wholly different in form; even so different that naturalists have arranged the progeny in another grand division of the Radiata, and the progeny afterward, by a species of budding, repeating the form of the original parent.

Yet, although seemingly so mysterious, is not this mode of development common in the vegetable kingdom? Is it not the prevalent process in the plants of our gardens and fields, with which we are all familiar? It is well known to us that in most plants, our trees and shrubs, for example, growth from the seed brings out a bud of leaves; from this bud, after elongation, other leaf-buds are often developed, each consisting, like the first, of a number of leaves. It is an admitted fact, that each of those buds is a proper individual plant, and that those constituting a tree are as distinct and independent as the several Polyps of a compound zoöphyte; and that the tree, therefore, is as much a com-

pound group of individuals as the zoöphyte. In some cases the plant forms but a single leaf-bud, in others, where there is successive gemmation for a period, the number is gradually multiplied, and more or less, according to the habit of the species. So among Polyps, there is the simple compound Tubularia, Campanularia, and the like. After the plant has sufficiently matured by the production and growth of its number of leaf-buds, there is a new development, a flower-bud, consisting of the same elements as the leaf-bud, but wholly unlike it in general appearance, as much so as the Medusa is unlike the Polyp. The flower-individual starts as a bulb from the leaf-individual, or the group of leaf-individuals, and is analogous in every respect to the bulbs from the Campanulariæ and allied species; and when it has fully matured it produces, like the Medusa, ovules or seeds, — these seeds to begin again the round of successive or alternating developments.

Thus among plants the seeds produce leaf-individuals; these yield bulbs or buds becoming flower-individuals; and these produce seeds, precisely as the egg produces Polyps, the Polyps bulbs that develop into Medusa, and the Medusa eggs.

When we follow out this subject minutely, we find the analogy completely sustained even in minor points of structure and growth. The leaf-bud consists of leaves developed in a spiral order, and in the Polyp, as some species show beyond doubt, the tentacles and corresponding parts are spiral in development. The same spiral character is found in the flower, but the volutions are so close as not to be distinguished readily from circles. In the Medusa referred to, the regularly circular form is far more neatly and perfectly developed than among Polyps. The only point in which the analogy seems to fail is that the Medusa-bud falls off before its full development, while this is not so with plants. It is obvious that this is unimportant in its bearing on this subject. It is a consequence of the grand difference in the mode of nutrition in the two kingdoms of nature; for the plant-bud on separation loses its only means of nutriment. The law of alternating generation is therefore no limited principle, strange and anomalous, applying only to a few Radiata. It embraces under its scope the vegetable kingdom, and it is but another instance of identity in the laws of growth in the two great departments of life. — *American Association, Silliman's Journal, by Prof. J. D. Dana.*

PHOSPHORESCENCE OF THE SEA.

M. QUATREFAGES has recently read before the Academy of Sciences an interesting memoir respecting the phosphorescence of the sea, in which he communicates the result of observations and experiments upon the animalcules which are now universally recognized as producing this phenomenon. His observations were made during a series of years on the French Atlantic coast near Boulogne. He calls these animalcules *noctiluca*, and describes them as of very simple yet curious organization. The body is formed of a globular diaphanous membrane, which is seen upon close inspection to be pierced with a very small hole. Internally is remarked a small collection of granulous matter,

from which start in every direction irregular filaments formed of the same substance. These filaments, which are eminently contractile, ramify and run into each other, forming a sort of woof, and always ending at the enveloping membrane, the inside of which thus appears lined with a very close network. To facilitate his observations M. Quatrefages isolated the animalcules by straining the water containing them through a towel. The brilliant noctilucs remained in the towel, and were thus obtained in any desirable quantities for the purposes of his experiments. The water having passed through the towel was totally deprived of its luminous quality, which was regained in its original degree upon replacing in it the animalcules which had been separated. For more convenient experiment, the animalcules were placed in a glass tube. On shaking the tube they became luminous. Upon applying to them a glass magnifying six or eight times, it was easily seen that, with the greater number the phosphorescence was only partial, appearing and disappearing successively upon several points of the body, while in other cases the whole body was luminous. With a microscope of increased power these facts became still more evident. Numerous brilliant points became visible, appearing and disappearing upon a luminous field. Apply now a very high magnifying power, and the brilliant points are multiplied in the same proportion. The luminous field disappears, and is proved to have been composed of an infinite multitude of very small lights. The phosphorescent parts of the animalcule, says M. Quatrefages, may be considered as *nebule*, which the microscope of sufficient power resolves into separate stars, only the stars, instead of being fixed, are so many instantly appearing and disappearing lights. Several interesting experiments exhibited the effects of an elevated temperature upon the noctilucs. At 25° Centigrade the phosphorescence began to manifest itself, and continued to do so with more and more brilliancy until the temperature reached 40° C. when the light became extinct. The effect of many of the gases was then observed. Chlorine was the only one which had the power to provoke the emission of light in a considerable degree, without the aid of agitation. The light emitted under its action was very brilliant, but soon ceased, and it was found impossible to renew it. — *Paris Correspondent of the National Intelligencer.*

NEST-BUILDING FISHES.

At the meeting of the American Association at New Haven, Prof. Agassiz made an interesting communication on the "care which certain fishes take of their young." After referring to the general disbelief with which stories of fishes taking care of their young have been received, he stated that recently, while engaged in collecting insects along the shores of Lake Sebago, in Maine, he was led to observe the actions of a couple of cat-fish, which at his approach left the shore suddenly and returned to the deeper water. This movement being several times repeated, he was led to a closer observation. The peculiar black appearance of the place which the fishes had left first attracted his particular attention. Examining more closely, a nest was

discovered, in which were moving a number of little tadpoles. These were at first taken for the tadpoles of frogs, and, to test the attachment of the old fishes to the spot, Prof. A. took some pains to experiment upon them. Pausing for a few moments, the two fishes returned slowly and cautiously, looking anxiously toward the nest to see if it had been disturbed. They approached to within six or eight feet of where he stood. They were evidently not in search of food, and he became convinced that they were seeking the protection of the young. Large stones thrown repeatedly into the middle of the nest, after these fishes had returned to it, only served to frighten them away for a brief period; they invariably returned to the spot within ten or fifteen minutes afterward. This was repeated for the fourth and fifth times, with the same result. The nest was in a depression among the water-plants.

RESUSCITATION OF FROZEN FISH.

THE following letter from a gentleman in Woodstock, Conn., published in *Silliman's Journal* for July, is confirmatory of the statement, that fish taken from the water in the cold of winter, and thrown upon the ice, after freezing quite hard, have been restored to their usual activity when placed again in cold water: — "Some time in the winter of 1838 or 1839, I was in the habit of catching fish, daily, by means of an eel-pot, which was so constructed as to receive and retain them without injury if taken out soon after capture. It was the custom to examine the pot in the morning. On one occasion, a severe cold morning, I drew up the pot and found a considerable number were taken. These were emptied upon the snow, and suffered to remain there until they became frozen as stiff as icicles. I carried them home, where they remained frozen for the space of an hour and a half longer, and so stiff and inflexible that they could not be bent without crackling, as did some of their tails and fins in pulling them apart when they were congealed together. I then put them into a tub of water drawn from the well, to thaw them for dressing, and I think added a small quantity of warm water. After some little time, I examined them, and to my surprise found some as lively as when sporting in their native brooks. I called on others to view them, who had seen them while frozen. To them also it appeared almost incredible, but we were compelled to believe our own eyes and senses. The fish in question are believed to have been perch."

THE DOMESTICATION OF FISHES.

In a memoir recently presented to the French Academy, M. Coste remarks, that, having had his attention directed to the domestication of fishes, he selected the eel to experiment upon, both because its manner of generating is almost wholly unknown, and because its flesh is not only agreeable to the taste, but constitutes an article of food very favorable to health. In proof of this latter statement, the author mentions the inhabitants of a section of France, who live almost entirely

upon eels, and who are notoriously healthy. In describing the manner of generation of eels, the author says, — "Every year in the month of March or April, there appear at the mouths of all the rivers, just at nightfall, myriads of transparent filiform animalcules from six to seven centimetres long, which raise themselves to the surface of the water in compact masses, and ascend the streams. These animalcules are nothing but newly hatched eels, leaving their birthplace to disperse themselves throughout the canals, lakes, and brooks, which communicate with the rivers." The quantity of these animalcules is sufficient to fill all the waters on the globe, and if transported to basins prepared to receive them they would furnish an inexhaustible supply of food.

Preoccupied with this idea, the author caused a quantity of these animalcules to be brought alive to the college of France, and placed in large wooden vats. The young eels were then from six to seven centimetres long, and one centimetre in circumference around the largest part of the body. After remaining seven months in the vat, they were twelve centimetres long, and two centimetres and two millimetres in circumference; at the age of eighteen months, twenty-two centimetres long, four centimetres and eight millimetres in circumference; at the age of twenty-eight, thirty-three centimetres long, and seven in circumference. Thus, though placed in very small basins, the eels grew from eight to ten centimetres in length, and two and a half in circumference, every nine months.

THE AMERICAN PORPOISE A NEW SPECIES.

At a meeting of the Boston Society of Natural History in January, Prof. Agassiz stated that the common porpoise of our waters, which has generally been regarded as identical with the *Phocaena communis* of Europe, proves upon examination to be a distinct and hitherto undescribed species. In *P. communis* the temporal groove of the skull is narrow and oblong; in the American species it is as wide as long. The general form of the skull is also different. In the European species the posterior surface is nearly vertical, in the American it is much curved. The teeth of the American species, although agreeing in general with those of the European in form, are grooved on the broad faces near the summit so as nearly to divide them into three lobes; in the European they are smooth. The dorsal fin is serrated and furnished with very characteristic tubercles in the American species, which are not mentioned in the descriptions of *P. communis*. Prof. Agassiz proposes as a name for this new species that of *P. Americana*.

CAUSE OF THE JET FROM THE BLOW-HOLES OF WHALES.

At a meeting of the Boston Society of Natural History, in February, Dr. Wyman made some remarks on the probable cause of the jet from the blow-holes of whales. While on a recent visit to Labrador, he had had an opportunity of observing this phenomena. Three causes for this jet had been assigned, namely, the water taken into

the mouth with the food of the animal, the water in the nasal cavities, and the secretions of the bronchial tubes. As it appears in the form of a sudden discharge of vapor, he thought a fourth explanation might be added, the sudden rarefaction of the air when inhaled, followed by a sudden condensation when emitted. He thought it was partly due also to the small quantity of water which entered the outer extremity of the nasal passages. He had succeeded in imitating the appearance in question, by introducing a small quantity of water into the end of a syringe and suddenly expelling it, with the body of air behind it, with considerable force.

Dr. Pickering said he could not think the condensation of the air when expelled from the lungs of a whale was a circumstance of much importance in forming the jet, as in tropical climates, where this could hardly occur, the jet was as complete as in colder latitudes.

Dr. Wyman said, that in some instances he had heard the inspiration, as well as the expiration, of Cetaceans. It follows the expiration instantaneously, but is much shorter and less audible.

Mr. Ayres, from his own observations, confirmed Dr. Wyman's views. He had noticed in a young porpoise that the act of breathing is much more slowly performed than in the adult.

BRAIN IN ARTICULATED ANIMALS.

M. FELIX DUJARDIN concludes, from observations made upon numerous species, that there exists in certain articulated animals a true brain, the structure and size of which correspond to the development of the intellectual faculties. It consists of well-marked symmetric brains complex in form, and of pedunculated bodies surrounded by a pulpy cortical substance, the more abundant in proportion as the instinct tends to predominate over the intellect. The peduncle is terminated above by radiated disks, and below divides into two tubercles, the one of which seems intended to communicate with the other half of the brain. The pulpy substance exists only in those insects in which instinct alone can be distinguished, and it alone constitutes the nervous ganglions of the chest and stomach, which preside over purely instinctive acts. The pedunculated bodies are the more developed in proportion as the intellect predominates over instinct; thus, in the bee, they form a fifth of the volume of the brain, and the nine hundred and fortieth part of the whole body, while in the beetle they do not equal a thirty-three thousandth. — *Paris Correspondent of the Courier des Etats Unis.*

BLIND ANIMALS OF THE MAMMOTH CAVE OF KENTUCKY.

PROF. WYMAN gave an account of dissections of some of the blind animals from the Mammoth Cave, Kentucky. In examining the fishes, his results were the same as Müller's, who found rudiments of eyes, or black points of pigment, but no cornea, no optic nerve, no ocular contents; as the small filaments of the fifth pair of nerves could be distinguished, he is confident the optic nerve could not have

escaped his careful examination, if it had existed. The optic lobes existed; according to the general rules of physiology, they should not exist, as they bear a strict relation to the sense of sight, which receives its nerves from them; both morbid and comparative anatomy show that disease of the eye impairing or destroying vision, or a naturally deficient sight, is accompanied with a corresponding diminution or atrophy of the optic lobes. Here the optic lobes were not so large as in the allied fishes, but yet they were of good size, and nearly as large as the cerebral lobes. This fact would lead us to inquire if these lobes are the seat of any other function than that of sight. In man, after long blindness, the lobe opposite the affected eye is found to be atrophied. Prof. Wyman had recently had in his possession a frog that had lost the sight of the right eye by the evacuation of its humors. The eye was cicatrized, and he had no means of knowing the age of the injury. On dissection, the left optic lobe was found one third less in size than the right. In the craw-fish of the Mammoth Cave, there is the eye-pedicle, but there are no facets; only simple integuments covered with hairs. The crickets, with their long antennæ, had as well developed eyes as crickets living in the light. — *Proceedings of the Boston Society of Natural History.*

RELATIONS OF EMBRYONIC DEVELOPMENT TO PERMANENT FORMS.

At a meeting of the Boston Society of Natural History, Prof. Agassiz said, that he had formerly shown that, in studying the relations of different stages in the embryonic development to permanent forms of insects, a better idea of their natural classification could be obtained than in any other way, and he now proposed to show that this view might be still further carried out, even to the fixing of the relative positions of the different families. It had been a question whether the diurnal or nocturnal butterflies should stand first in the scale. He proceeded to show that the different positions and relations of the wing in the progress of development of *Papilio* correspond to the permanent conditions of these appendages in the various families of *Lepidoptera*, and thence deduced their true position; placing, 1st, *Papilionidæ*; 2d, *Hesperidæ*; 3d, *Sphingidæ*; 4th, *Bombycidæ*; 5th, *Noctridæ*; 6th, *Pyralidæ*; 7th, *Tineidæ*. In a similar way he indicated the true position of the different types of *Articulata*, showing a close analogy between their permanent forms and the transient conditions of an insect, beginning with the caterpillar, which corresponds in type with the *Annellidæ*. By the same test he showed the true position of *Millipedes* and *Spiders*; the former being insects with a worm-like form, the latter, with the anterior parts united into a cephalothorax like the *Crustacea*, corresponding to the pupa condition in type.

WEIGHT AND VALUE OF EGGS.

It is most extraordinary, that the varieties in the weight and value of eggs, as an article of merchandise, should have been so universally

overlooked. So far as known, it has always been the custom everywhere to sell eggs by number, without respect to size, weight, or peculiar quality. Yet no absurdity can be greater. It has been ascertained, by careful experiments recently made by the author, that the fair average weight for a dozen of eggs is $22\frac{1}{2}$ oz. Recently, on application to a provision-dealer, he made answer to the inquiry addressed to him, that he made no difference in the price of his eggs. On examination of his stock, it appeared that the largest eggs weighed 24 oz. per dozen, and the smallest only $14\frac{1}{2}$ oz. In the one case, a fraction over eleven eggs would equal the average weight of a dozen, and in the other it would require over 18 eggs to reach the proper weight. It appeared, to our mutual astonishment, that the difference in weight between the two kinds was about one half, while the price was the same. — *Dr. Bennett's Poultry Book.*

PARASITES AND THEIR RELATIONS TO OTHER ANIMALS.

At a meeting of the Boston Society of Natural History in February, Dr. Burnett presented a communication on the relations of an order of parasites (lice) to the different Fauna, as bearing, first, on the distinct creation of types of animals, and, second, on the local creation of these types wherever they are found. In the general Fauna of the earth, the fact that totally distinct genera and species exist, exposed to the same external influences, is a strong argument against their being the results of modifications of a single type, and in favor of their having been created as we now see them. The same is true as regards these parasites; we have different species, and even different genera, upon a single animal, all exposed to the same external changes. If genera and species are mere modifications of a primitive family type, we should expect to find a uniformity in the special character of parasites in all the species of the genera of that family. For instance, if the Sciuridæ are but modifications of a primitive type Squirrel, we should expect to find certain parasites common to all, with a uniform specific character, without widely separated genera; which, as far as his experience goes, is not true, for though in many cases certain species of parasites are common to the whole family, yet there is an evident tendency for each species of the higher animals to have its own peculiar species of parasites. Though we can easily imagine that the same species may be found in mammals and birds of the same family, with similar habits, and associating together, we cannot understand that the same species of parasite should be found in widely different families, of entirely dissimilar habits; yet such is the fact, and it is not reconcilable with the hypothesis of a successive production of types by a series of changes of their structure; on the contrary, it would go to show that the existing specific types were as such created.

As to the local creation of genera and species, we know that the existence of the world's animals has not that commonness which might be supposed; they have relations of a local nature, connected with a remarkable diversity of forms. At any rate, this fact is certain, that each particular region has a marked tendency to have its own peculiar

Fauna. Climate has undoubtedly a great influence on the character of a Fauna; we see in the same zone, separated by impassable barriers, a tendency to similar animal productions, though there is at the same time sufficient diversity to exclude the idea of a common origin; different countries have analogous, not identical, species. Geological data, the history of the surface of the earth, and our fast increasing knowledge of the intimate relations of animals to the circumstances in which they live, all lead to the conclusion of their local creation in their present habitats. The relations of parasites afford considerable proofs against the hypothesis that the differences of terrestrial conditions have caused the differences in animals. We could not suppose that the lice living on European birds would be different from those of the analogous species of American birds, if they arose from a common stock; their parasites ought to agree as to species. This is not the fact; not only do the parasites of our animals, compared with analogous species in Europe, present differences greater than those of the animals on which they live (their species being more distinct than those of the higher animals), but even our species of birds or mammals, having no representative on the other continent, have their own parasites as distinct as themselves. Those animals which, by their own powers of locomotion, or by human means, are common to both continents, have parasites identical in character, as far as observation goes. The lice of our cow, horse, or hog do not differ from those of the same animals in Europe; the same is true of some birds. The legitimate inference from these facts is, that the analogous species of animals of the different continents were created as such, and therefore have their proper parasites, and did not emanate from parent stocks.

Man himself is fortunately annoyed by but few parasites; his ubiquity renders the conditions of his existence different from those of other animals. Many of the higher mammals man has gathered around him in domestic life; and, as they go wherever he goes, the facts relating to them can have no great weight. The lice of the *Quadrupedia*, or monkeys, seem to be different from those of man; in fact, the species of man are not found on the monkeys, except when their presence may be accounted for by accident; and those of the monkeys are found only on them.

Dr. Burnett has also established to his satisfaction the following facts:—1. That although there are single species of parasites peculiar to particular animals, there are others which are found in different species of the same genus, as is the case in the parasites living on birds of the genus *Larus* (gulls), and the diurnal birds of prey. 2. The parasites of the human body confine themselves strictly to particular regions; when they are found elsewhere it is the result of accident. Thus, the *Pediculus capitis* lives on the head; the *P. vestimenti* upon the surface of the body; the *P. tabescentium* on the bodies of those dying with marasmus; and the *Phthirus inguinalis* about the groins, armpits, mouth, and eyes, or the homologous parts of the body. From an examination of the structure of these animals, Dr. Burnett is of the opinion that they should be placed in an order by themselves,

closely allied to the Insecta; they number about 250 species, the Mandibulate parasites occupying the highest, and the Haustellate the lowest position in the order.

Dr. Burnett also stated that he had recently found vegetable parasites in the human ovum. They belonged to a species of *Conferva* similar to the yeast plant. They appear in triplets, or by twos, and were about one 4,000th of an inch in diameter. It was difficult to account for their presence in such a situation, as their spores would be too large to be deposited from the circulation by passing through the walls of the blood-vessels.

FALL OF DUST.

A REMARKABLE fall of dust accompanying snow took place at Olsterholz, near Detmold, in February, the wind being from the southwest. It covered the earth to the depth of two thirds of a line. Ehrenberg has detected in it fifty organic forms, of which forty had been before observed by him in similar circumstances, while ten species were for the first time observed in dust transported by the winds. None of the species were new. — *Monatsbericht of the Berlin Academy, April.*

ON PARASITIC LIFE.

Dr. J. LEIDY has established the fact, that cryptogamic vegetables exist, as a normal condition, in the interior of several species of healthy animals. He describes three new genera of entophytes, — *Euterobrus*, *Cladophytum*, and *Arthromitus*, — all being confervoid or mycodermatoid. All are found growing from the mucous membrane of the small intestine and commencement of the large intestine of *Julus marginatus* (Say), and from entozoa inhabiting these cavities in the same animal. They were uniformly found in one hundred and sixteen examinations of animals of this species, made immediately after death. In one instance, an ascaris, three lines long, "had no less than twenty-three individuals of *Euterobrus*, averaging a line in length, besides a quantity of the other two genera, growing upon it, and yet it moved about in so lively a manner that it did not appear the least incommoded by its load of vegetation."

The important point in these observations is, that they show that cryptogamic vegetables may exist in the internal organs, and upon entozoa inhabiting these organs, without disturbing the health, and even as an ordinary and normal condition. This does not rebut the idea that other Cryptogamia may produce diseases. They are known to exist in aphthæ, in many diseases of the skin, have been found in the secretions of cholera and several acute diseases, and were lately observed by Dr. Leidy in a case of softening of the stomach. Whether in these instances they are the cause or effects of the morbid state, or even a mere coincidence, is not decided. Dr. Leidy regards the microscopic forms known as *Vibrio* as vegetable. In this opinion he is supported by other observers. After mentioning the discovery of several species, and a new genus of entozoa, he notices the exist-

ance of *Gregarina* in the ventriculus of *Julus marginatus*. *Gregarina* has recently attracted much attention, as being supposed to be an animal consisting only of two cells, and said by Diebold to be destitute of an alimentary canal. Dr. Leidy describes a papilla surmounting the superior cell, with traces of an external communication with the cavities of the cells. He regards it as the larva of the entozoon. — *Proceedings of Academy of Natural Sciences, Phil.*

ON THE PHYSIOLOGY OF GENERATION.

At a meeting of the Boston Society of Natural History, in March, Dr. Burnett read a paper on the embryology of Articulata, as illustrating some obscure phenomena in the physiology of generation. In the formation of the extremities of insects, a process takes place similar to that of the first stages of development of the whole body. As the whole body was at first a cylindrical blastemal mass, subsequently marked by transverse grooves indicating its articulated character, so the limbs are primarily cylindrical tubes, afterwards divided transversely into different joints. The true typical characteristics of species belong to the primitive ovum; and consequently little weight should be given to the theory of the change of such characters, or the introduction of new ones by external influences. Thus, as the wings of insects are only expanded tracheæ, and consequently belong to their primitive characteristics, their actual existence might have been predicated at an earlier period than they had been supposed to exist before the recent investigations of Burmeister and Agassiz. Some singular facts are observed in the generation of the humblebee and aphides. In the former three successive broods of offspring are produced from one act of impregnation; the first brood, he believed, being alone produced from eggs directly impregnated. In the aphides, a succession of broods is produced, sometimes to the number of ten or eleven, each being the offspring of the preceding, and all the result of the impregnation of the parent of the first.

Dr. Burnett proceeded to examine Owen's and Steenstrup's views as to the nature of the process by which this succession of generation was effected, stating that they did not accord with his own. He thought the phenomena were not anomalous, but consistent with the highest and most philosophical views of the essential nature of generation. He explained the process, which he had observed, of the division of the sperm cell by which the spermatozoon is produced, describing it as similar to the division of the ovum in the female. The function of the spermatozoon is to awaken, by contact, the slumbering force which led to the formation of the embryo in the ovum, a process similar, he thought, to that in the inorganic world known as the process of catalysis, as in the instances of the immediate magnetizing of iron by contact with a magnet, and the production of water from a union of hydrogen and oxygen by the contact of spongy platinum. As the particles of magnetized iron have the power of transmitting to others, by mere contact, the property communicated to them, so the cells of the ovum, being, so far as is known, in their nature precisely

similar to each other, may in certain instances be supposed to be able to communicate to another ovum the force which has spread to them all, from the contact of a spermatozoon. In the case of the aphides, the females which are produced directly from the act of impregnation retain in themselves the property of awakening the power of development in the ova produced in their ovaries, and this power is transmitted from one brood to another until it finally dies out,—a process which seems to have its analogue in the disposition to the production of adventitious growths in the ovary, which is sometimes seen to be hereditary in the human female. In the humblebee it would seem that the ova from which the first brood are produced are fertilized directly by spermatozoa; that the ova transmit the awakened force to those which produce the second, and these in their turn to those which produce the third.

DISCOVERY OF A LIVING SPECIMEN OF A BIRD SUPPOSED TO
BE EXTINCT.

A LETTER from Dr. Mantell, published in *Silliman's Journal* for Jan., 1851, states that his son, Mr. Walter Mantell, of New Zealand, has discovered a living specimen of a genus of Rallidæ, of which crania, with the humerus, sternum, and other parts of the skeleton, were found by him associated with the remains of the colossal Moas in the sand deposit near Waingongoro, on the western shores of the North Island. The fossil bird was referred by Prof. Owen to a new genus, and he named it *Notornis Mantelli*. There was a tradition among the natives that contemporaneously with the gigantic birds there existed several small ones of various kinds, and a species of *swamp-hen* was particularized as having been abundant down to a late period, but was supposed to have been exterminated by the wild cats and dogs. It was said to be of the size of a small turkey, black, without wings, and with red beak and legs. It was called *Takehé* and *Moho*. On a second visit to the southern parts of the Middle Island, Mr. Mantell obtained a fine example of the supposed extinct *Notornis*. The sealers when frequenting the coasts of Dusky May perceived on the snow the track of a large and strange bird, which they followed a considerable distance, and at length caught sight of the object of their search, which fled very rapidly from the dogs, but was driven up a gulley in a sound behind Resolution Island and caught alive. It screamed loudly, and resisted fiercely. After being kept alive for a few days, it was killed, but the skin, with the head and legs, were preserved. The bird is about two feet high, much resembling in its general form the *Porphyrio melanotus*, but it is generically distinct. The beak is short and strong, and was, as well as the legs, when the animal was alive, of a bright red color. The neck and body are of a dark purple, the wings and back being shot with green and gold. The wings are short and rounded, and remarkably feeble, both in structure and plumage. The tail is very scanty, and white beneath. It is undoubtedly identical with the fossil. This discovery has an important bearing on the problem as to the contemporaneity of the Moa and its kindred with species of which there are still living representatives.

Accompanying the above were specimens of various rare birds, among them the *Strypops*, *Neomorpha*, *Apteryx Australis*, and *A. Oweni*.

REMAINS OF THE DODO.

THERE has recently been discovered in the museum at Prague another veritable skull of the Dodo, the existence of which has hitherto been unsuspected. This is the third instance in which remains of this extinct bird have been discovered among the rubbish of European museums.

CURIOUS HABITS OF BIRDS.

THE result of some curious investigations in relation to certain habits of birds, undertaken by M. Dureau de la Malle, of Paris, has recently been published. He was anxious to ascertain at what hour different birds began their morning song; he therefore, from the 1st of May to the 6th of July, made observations, which he regularly published. It appears that for thirty years this vigilant naturalist went to bed at seven o'clock in the evening, and rose at midnight, during spring and summer, and that this habit was for scientific purposes. It seems that the concert is opened about one o'clock by the chaffinch, and that the sparrow is the laziest bird, not leaving his rest until five o'clock. In the intermediate hours, at marked intervals, which M. de la Malle has carefully noted down, other birds commence their natural melody. He has shown, on more than one occasion, that the different birds have mistaken artificial light for the dawning of day, and that a solar lamp has awakened the little choristers.

HIPPOTAMUS IN ENGLAND.

THE first living specimen of the hippopotamus ever imported into Europe has, during the past year, been presented by the Pacha of Egypt to the Queen, and by her to the Zoological Gardens of London. The animal in question was captured in August, 1849, on a remote branch of the Nile, 1,350 miles above Cairo. The hunters, having previously wounded its mother, had their attention attracted to the thick bushes on the river's bank, in which the young animal was concealed. When discovered, the calf made a rush to the river, and nearly escaped, owing to the slipperiness of its skin, and was only secured by one of the men striking the boat-hook into its flank. The hippopotamus is now only ten months old, and measures 7 feet long and 6½ in girth at the middle of the barrel-shaped trunk, which is supported clear of the ground on very short and thick legs. The naked hide covering the broad back and sides is of a dark, India-rubber color, impressed by numerous fine wrinkles crossing each other, but disposed almost transversely. When Prof. Owen first saw the beast, it had just left its bath, and he observed a minute drop of a glistening secretion exuding from the pores, which are dispersed over the whole integument, and which the animal is provided with for the

purpose of lubricating its thick hide, and thus preventing it from breaking. When in the water its whole aspect seems changed, and the animal becomes inspired with a new life and activity. Sinking down to the bottom, and moving about when submerged for a while, it will suddenly rise with a bound almost bodily out of the water, and, splashing back, commence swimming about with a porpoise-like motion, taking in mouthfuls of water and spurting them out again, raising at intervals its grotesque head, and biting the wood-work at the margin of the tank. In the water, from its broad rounded back being principally in view, it has the appearance of a much larger animal than when seen upon land. It is extremely docile, and follows its Arab keeper like a dog. Its food is a kind of porridge of milk and corn-meal.

At a late meeting of the Boston Society of Natural History, extracts of a letter from Sir Charles Lyell were read, in which he alluded to the great advantages which the hippopotamus had conferred on the Zoölogical Society. The creature cost the Society about £1,500; but from the proceeds of its exhibition this sum had not only been paid, but a splendid collection of reptiles had been added, and the Society freed from all pecuniary embarrassments.

NEW BREED OF RABBITS.

At a recent agricultural exhibition held at Chatham, England, a new variety of rabbits was exhibited, chiefly remarkable for the enormous length of their ears. In one animal, a buck, the length of the ear was $21\frac{3}{4}$ inches; in another, a doe, $21\frac{1}{4}$ inches, with a breadth of nearly 5 inches.

ON THE SERPENT OF THE BIBLE.

PROF. OWEN, the distinguished English naturalist, in his work on British reptiles, makes the following remarks on the serpent of the Bible:—The discovery of serpents of different genera and species, all manifesting the peculiar and characteristic vertebral organization of true *Ophidia*, at a period incalculably remote from that at which we have any evidence of the existence of man, viz. the eocene tertiary, forcibly recalls our early ideas of the nature and origin of serpents derived from annotations of Scripture which represented them as the progeny of a transmuted species, degraded from its originally created form as the consequence and punishment of its instrumentality in the temptation of Eve. "The curse upon the serpent," say the learned Drs. D'Oily and Mant, "consisted, 1st. In bringing down his stature, which was probably, in a great measure, erect before this time; 'Upon thy belly shalt thou go'; 2dly. In the meanness of his provision, 'and dust shalt thou eat,' insomuch as creeping upon the ground, it cannot but lick up much dust with its food." The idea of the special degradation of the serpent to its actual form, derived from interpreting the sentence upon it as a literal statement of fact, has been so prevalent, as to have affected some of the zoölogical treatises of the last century. Thus, in a "Natural History of Serpents," by Charles Owen,

D. D., published in 1742, the author, treating of the food of these reptiles, writes, — "That dust was not the original food of the serpent seems evident from the Paradisiac serpent, but the necessary consequence of the change made in the manner of its motion, i. e. the prone posture of its body, by which it is doomed to live upon food intermixed with earth." Adam Clark, commenting more recently upon the record in its literal sense, seeks to elude the difficulties which thence arise, by contending that the Hebrew, "nachash," may be translated "ape," as well as "serpent." But we find him reduced to the necessity of glossing the text by such expositions, as that to go on the belly means "on all fours"; and by affirming, of the arboreal frugiverous four-handed monkeys, that "they are obliged to gather their food from the ground," we have a lively instance of the straits to which the commentator is reduced who attempts to penetrate deeper than the Word warrants into the nature of that mysterious beginning of crime and punishment, by the dim light of an imperfect and secondhand knowledge of the Divine works. If, indeed, the laws of animated nature formed part of the preliminary studies of the theologist, the futility of such attempts to expound the third chapter of Genesis, viewed as a simple narration of facts, would be better appreciated by him; and if he should still be prompted to append his thoughts, as so many lamps by the side of the sacred text, he would most probably restrict himself to the attempt to elucidate its symbolical signification.

What geology and anatomy have unfolded of the nature of serpents, in regard to their present condition, amounts to this; — that their parts are as exquisitely adjusted to the form of their whole, and to their habits and sphere of life, as is the organization of any animal which we call superior to them. It is true the serpent has no limbs, yet it can outclimb the monkey, outswim the fish, outleap the jerboa, and, suddenly loosing the close coils of its crouching spiral, it can spring into the air and seize the bird upon the wing; thus all these creatures fall its prey. The serpent has neither hands or talons, yet it can outwrestle the athlete, and crush the tiger in its folds. Far from licking up its food as it glides along, the serpent lifts up its crushed prey, and presents it, grasped in the death-coil as in the hand, to the gaping, slime-dropping mouth. It is truly wonderful to see the work of hands, feet, fins, performed by a simple modification of the vertebral column in a multiplication of its joints, with mobility of its ribs. As serpents move chiefly on the surface of the earth, their danger is greatest from pressure or blows from above; all the joints are accordingly fashioned to resist yielding, and to sustain pressure in a vertical direction; there is no natural undulation of the body upwards and downwards, it is permitted only from side to side. So closely and compactly do the ten pairs of joints between each side of the two or three hundred vertebrae fit together, that even in a relaxed and dead state the body cannot be twisted, except in a series of side coils. Of this the reader may assure himself by an experiment on a dead and supple snake. Let him lay it straight along a level surface; seize the end of the tail, and, by a movement of rotation between the thumb and finger, endeavour to screw the snake into spiral coils; before he can produce a single

turn, the whole of the long and slender body will roll over as rigidly as if it were a stick. When we call to mind the anatomical structure of the skull, the singular density and structure of the bones of the cranium strike us as a special provision against fracture and injury to the head. When we contemplate the remarkable manner in which all the bones of the skull overlap one another, we cannot but discern a special adaptation in the structure of serpents to their commonly prone position, and a provision for the dangers to which they were subject from falling bodies, and the tread of heavy beasts. But the whole organization of the serpent is replete with many other such beautiful instances of foresight and design. What, however, more particularly concerns us in the relation of the serpent to our history is the great and significant fact revealed by palæontology, viz. that all these peculiarities and complexities of organization, in designed subserviency to a prone posture and a gliding progress upon the belly, were given by a beneficent Creator to the serpents of that early tertiary period of our planet's history, when, in the slow and progressive preparation of the earth, the species which are now our contemporaries were just beginning to dawn; these, moreover, being species of the lowest classes of animals, called into existence long before any of the actual kinds of mammalia trod the earth, and long before the creation of man. — *Jame-son's Journal, Oct.*

CHOLERA IN ANIMALS.

EVIDENCE was produced to the French Academy in July, showing that, during the prevalence of the cholera in France, horses were observed to be affected with the disease in a like manner with men, and that often, in the case of other epidemics, a common liability of men and horses had been noticed.

CHANGES OF INTEGUMENTS BY ANIMALS.

SIR J. G. DALYELL presented to the British Association, at Edinburgh, the results obtained by him from observations upon the Crustacea. He described minutely the changes undergone by crabs during the process of moulting, and in several instances he counted the number of days from one moult to another. These varied from 60 to 194 days. In all cases he found that no separation of wounded, mutilated, or destroyed parts took place till after the moult following the injury. In one case of the moult of a crab, only the two claws of the dermal skeleton were developed, whilst the eight legs were entirely suppressed, but appeared at the next moult.

Dr. T. Williams in a paper on Crustacea remarks that the process of shedding the exuvix seems to be in a great measure under the control of the animal, as when watched it frequently suspended this operation, or when excited hastened it. The process seems to be attended with excitement of the nervous system, as at this period the animal is more pugnacious than at any other. — *London Athenæum, August.*

THE SENSES IN THE ANNELIDES.

At the close of a paper on the organs of sense in the Annelides, M. de Quatrefages gives the following as the conclusions to which he has arrived. 1. The Annelides possess all the senses except that of smell, which is probably blended with that of taste. 2. In most of them these senses have special organs for their exercise. 3. These organs may become defective, and then the exercise of its functions probably becomes less perfect. 4. The sense of touch is most commonly exercised by the aid of appendages to the head, though in certain cases the appendages of the tail appear to perform the same functions. 5. The sense of taste probably has its special seat at the inner surface of the proboscis, especially in the species where this organ is more or less exsertile. 6. Most of the Annelides have real eyes, which are sometimes placed elsewhere than on the head, and receive their nerves from other nervous centres than the brain. 7. Some of the *Annelides* have organs of hearing like those of the gasteropod mollusks; these organs are not cephalic.

RESPIRATION OF ANIMALS.

ACCORDING to Mr. Grove, in a lecture delivered before the Royal Institution, M. Regnault, in his researches on the respiration of animals, has ascertained that warm-blooded animals exhale nitrogen in proportion, from one fiftieth to one hundredth or less, to the oxygen breathed. Animals deprived of food absorb nitrogen in proportions similar to those in which it is exhaled in the first cases. Animals, when ill, or suffering from unusual food, also absorb nitrogen. With animals nourished on pernicious food, the carbonic acid exhaled is generally nearly equivalent to the oxygen inhaled. When fed on animal food, the proportion of carbonic acid is much less, in some cases not more than six parts to ten of the oxygen inhaled. Consumption of oxygen, compared with the weight of the animal, is ten times greater in the case of small animals, like sparrows, than with larger ones, like fowls. With hybernating animals, such as marmots, no unusual phenomena are presented when awake, but in their torpid state they consume much less oxygen, can live in an atmosphere which would not support them when awake, give off but little carbonic acid, and absorb so much oxygen and nitrogen as frequently to increase in weight by respiration alone. Cold-blooded animals consume very little oxygen, and breathe considerably through the skin; insects require as much oxygen as mammals. — *London Literary Gazette*, January.

THEORY OF THE SPLEEN.

At a meeting of the Surgical Society of Ireland, on the 9th of March, a deeply interesting and highly scientific theory, regarding the uses of the spleen, was propounded by Sir James Murray, which he stated to be the result of experiments carried on during twenty years. The following are some of his deductions: — "1. It appears

that series of electric currents emanate from the spleen to the stomach during digestion. 2. That the activity of these currents varies, according to the degree of splenic distention by the blood through the vessels of the spleen. 3. That the currents of electricity are more intense, in proportion to the blood's heat, to the pressure exerted on the spleen during inspiration, and to the impulse and friction of the circulation in the large splenic arterial branches. 4. That, in a minor degree, similar phenomena ensue, even out of the animal, when a recent spleen is insulated, and then injected with warm water, but still more so, with hot liquors, containing such saline ingredients as prevail in the blood. 5. That a spleen recently taken from an animal, when insulated and injected with tepid fluid, determines a positive current towards the gastric surface of the spleen when tested delicately by gold and silver wires. 6. That contraction of erectile tissue ensues when the extremities of a gold and silver wire touch at one point the nerve, and at another the erectile tissue of the spleen. 7. That contraction, to some extent, seems to be produced, when two cups filled with water are united by a metallic arc, one end of a spleen being immersed in one of the cups, and the opposite extremity in the other cup. But so many uncertain deviations of the electrometer needles occur during this experiment, that more experience is required to arrive at surer data regarding this part of the trials. 8. That disks or slices of spleen, placed upon each other, were in most instances better voltaic piles than similar batteries constructed from equal weight of brain, liver, kidney, pancreas, or even of muscular flesh. 9. That slices of spleen are better conductors than equal sections of any of the above materials, particularly when moistened by warm saline fluids, or even by tepid distilled water. 10. That the intensity of galvanic currents along the vasa brevia, from the spleen to the stomach, continues through the gastric coats in the recently swallowed ingesta, and that the liquor called gastric juice seems thereby to derive and exert some galvanic influence upon the pulpy aliment, whereby chemical action and digestive assimilation appear to be set up and maintained among dissimilar atoms of nutriment. 11. That, so far as the stomach and its contents are concerned with electric agency, they are more particularly to be considered as *passive receivers or conductors* of galvanic influence, but that the spleen is endowed with active powers of generating or creating voltaic evolutions, under favorable degrees of repletion of its vessels, tension of its erectile tissue, and of auxiliary thermo-electric principles. There are no other passages except the veins and lymphatics to carry away any secretion or modified fluid from the spleen to the stomach. But additional degrees of temperature can be readily communicated by means of membranes and tissues in actual contact. In like manner, the same conductors can rapidly convey electric energy to the stomach and its contents without intermediate vessels or efferent ducts. Here I wish to avoid the analogy of parts of animals admitted to be endowed with independent electric powers, and also to omit arguments drawn from the anatomical structure of the spleen, but I merely observe, that a natural pile or soft battery seems to be constituted in the spleen by its links of soft

pulpy corpuscles, each containing a liquor, not one of them isolated, but all chained to each other by delicate conductors of moist threads, uniting disk to disk, like the knots of a cord. I have many times noticed that, under favorable circumstances, this curious pile, so well and beautifully connected, cell to cell, is capable of generating or conveying voltaic influence, which agency seems to furnish another argument, that 'nothing was made in vain.' "— *Boston Medical and Surgical Journal*, August.

EXPERIMENTS ON THE MOTOR POWERS.

DR. DOWLER, of New Orleans, has recently published the results of some curious experiments made by him on alligators. One alligator, after the spinal marrow had been cut across between the shoulders and the hips, "during a period of two hours, displayed complete intelligence, volition, and voluntary motion in all divisions of the body." The signs from which Dr. Dowler makes this inference were associated and adaptive movements of the lateral muscles of the body, and of the hind legs, in response to irritations applied to the viscera, or above the part of the spinal marrow which was divided. Others showed similar powers after decapitation, or after the brain and medulla had been removed. In one case, these movements were produced by "pinching, puncturing, and burning," for three or four hours after the head was cut off. The separated heads, until the brain was destroyed, continued to show their vitality by biting, winking, looks of anger and fear, and in one pathetic instance by affectionately recognizing the voice, and eyeing the movements of a fond negro! One alligator was decapitated with a dull hatchet, producing little hemorrhage. Dr. Dowler thus relates the sequel; "I carried the handle towards the eye, to ascertain whether it would wink, whereupon the ferocious separated head sprang up from the table with great force at me, and alighted upon the floor six or eight feet distant from its original position, passing very near my breast." Dr. Dowler, who is familiar with the anatomy of the alligator, can find no muscle to account for this feat. The experiments would appear to show that, after the spinal marrow was thoroughly divided, the *lower* limbs moved on irritants being applied to the *upper* part of the trunk. This fact, if it should be confirmed by larger experience, would not be in accordance with numerous and trustworthy observations of physiologists. The heart was seen to beat after being freed from blood, separated from the nerves, roughly handled, and considerably desiccated; well illustrating its inherent contractile power.

These statements, which seem almost incredible, we give on the authority of the "Report of the Committee of Medical Sciences," presented at the third annual meeting of the American Medical Association. — *Editors.*

RAPIDITY OF THE NERVOUS CURRENT.

In a paper presented to the French Academy on Feb. 25, "On the

rapidity of the propagation of the nervous agent in the spinal nerves," M. Helmholtz describes at length some experiments of his, from which he concludes that the nervous irritation passed over a space of 50 to 60 millimetres in from 0.0014 to 0.0020 of a second. The frogs experimented on had been kept at a temperature of 2° to 6° Centigrade, while that of the laboratory was 11° to 15° . The lower the temperature, the less appears to be the rapidity of the nervous agent.

DIRECT EXPLORATION OF THE INTERIOR OF THE EYE.

Dr. S. Wood, of Cincinnati, has described a phenomena which suggest a new mode of direct exploration. He states that, by means of a small double convex lens, of short focus, held near the eye, that organ looking through it at a candle twelve or fifteen feet distant, there will be perceived a large luminous disk, covered with dark and light spots and dark streaks, which, after a momentary confusion, will settle down into an unchanging picture; which picture is composed of the organs or internal parts of the eye. The eye is thus enabled to view its own internal organization, to have a beautiful exhibition of the vessels of the cornea, of the distribution of the lachrymal secretions in the act of winking, and to see into the nature and cause of *musca volitantes*. — *Western Lancet*, Nov., 1849.

ANIMAL HEAT.

M. MAGENDIE, in his lectures at the College of France, has detailed some experiments upon the effects of extremes of temperature upon animals. The object in view was the solution of the questions, Whether animals really possess the power of preserving their temperature, whatever may be that of the medium surrounding them? What are the limits of the temperatures they can support? What are the phenomena which accompany death caused by extremes of temperature? Rabbits, dogs, and guinea-pigs were employed, and the temperature ascertained by a thermometer introduced into the rectum. *Effects of high temperature*: — Death occurred the more rapidly, *ceteris paribus*, the higher the temperature employed. Thus, of five rabbits, the first exposed to 248° F. died in 7 minutes, and the last, exposed to 140° , in 33 minutes. Three dogs, exposed respectively to 212° , 194° , and 176° , died in 18, 24, and 30 minutes. The same rule applies to birds, but they bear high temperature for a shorter period than mammals. Cold-blooded animals endure it longer. Rabbits exposed from 140° to 212° lost in weight about 15 grains per minute. The loss was not so much in proportion to the degree of elevation of temperature, as to the duration of a high one; and it is dependent more upon pulmonary transpiration than cutaneous. Thus a rabbit placed in the heated stove with its head out lost only 10 grammes, while one with its head within and its body out, lost 25 grammes. A living rabbit, having a temperature of 102° , and one just killed with a temperature of 87° , were placed in the stove at 176° . After 20 minutes, the former died convulsed, having acquired a temperature of 112° in

all parts of its body, while the dead one exhibited a temperature of 122° to $125\frac{1}{2}^{\circ}$ externally, and of only $107\frac{1}{2}^{\circ}$ in the rectum. Thus, while the living animal dies long before an equilibrium can be established, this is gradually effected in the dead one. Mammals always died when exposed to a temperature of 113° or 115° ; birds at $118\frac{1}{2}^{\circ}$; cold-blooded animals, when exposed to that of 176° , died when their own reached 104° . In moist heated air death is far more rapid.

Effects of low temperature:—While an elevation of the temperature of animals is not borne beyond 8° or 10° , it may be lowered to a far greater extent. Dogs and rabbits, exposed to a freezing mixture, their own temperature being 104° , lost $5\frac{1}{2}^{\circ}$ in 10 minutes, 11° in 15 minutes, and $12\frac{1}{2}^{\circ}$ in 20 minutes. The general conclusions are, — 1. An animal placed in a temperature of from 32° to 46° , during not more than 5 minutes, undergoes a diminution that may lower it to two thirds of its normal temperature. 2. This diminution continues after removal from the cooling mixture. 3. Left to itself, it takes place, until, having arrived at nearly half of the normal temperature, the animal dies; but if this point has not been attained, the application of warmth may yet restore the normal temperature. Various experiments show that even warm baths diminish internal heat, and if we wish to produce the full effect, the person must not be dried or rubbed too soon after leaving them, lest a premature reaction interfere with the refrigerant effect. In the recovery of drowned persons, too, the administration of warm fluids by the mouth or rectum is of the first importance. Animals whose temperature varies from $100\frac{1}{2}^{\circ}$ to 112° become anæsthetic when this is reduced to 75° or 77° . Experiments made since 1842, by covering the bodies of animals with gum, gelatine, caoutchouc varnish, or other substances which dry rapidly, and do not impede the respiratory movements, show that the animals so covered die in from two to eight hours, the circulation having become almost completely arrested in the large vessels. All these experiments demonstrate the intimate relation between the functions of the skin and the animal temperature. — *L'Union Medicale*, 1850, Nos. 45, 46, 47.

TEMPERATURE OF CHILDREN.

ONE of the memoirs which received a prize in "medicine and surgery" from the French Academy, was by M. Roger, on "the temperature of children." In the investigation of this subject, the author has made more than a thousand experiments. At the moment of birth the temperature of the infant is 40° Centigrade, that is, equal to that of the medium in which it lived; but it soon decreases to 35° . In the following years it varies from 36° to 38° . The typhoid fever is the sickness in which the temperature is the highest, varying from $42^{\circ}.5$ to 41° ; in pneumonia it is 39° on an average, and in eruptive fevers it varies with the periods of the disease. In *meningites* there are the greatest differences of temperature, depending more upon the individuals than upon the severity of the disease. In only one disease, the hardening of the cellular tissue, is there a very great decrease in the temperature; in nineteen children, the thermometer under the

arm-pit marked 33° ; in seven, less than 26° ; in two others 23° , and even 22° , that is, 15° below the ordinary temperature. The temperature in several other diseases is also given by M. Roger. — *Comptes Rendus*, March 4.

THE FUNCTIONS OF THE PANCREAS.

THE report of the committee of the French Academy, appointed to award the prize of experimental physiology for 1848, is contained in the *Comptes Rendus* for March 4. They award the prize to M. Bernard, and observe, — “The successful memoir contains the important and unexpected discovery of the functions of the pancreas in the complicated and little understood process of digestion. It places beyond a doubt the fact that the liquid secreted by the pancreas has the special function of dissolving the fat of the food, and in general all neutral fat, or more exactly vegetable and animal substances. The pancreatic liquid possesses this property to such an extent, that if from any cause its secretion is suspended, the fatty matter introduced into the stomach with the food traverses the intestinal canal without undergoing the least alteration. The author, not content with establishing this fact, explains it as follows. It is known that for several years chemists have directed their attention to different substances, which, when placed in contact with certain bodies, present some peculiar reaction; such are the greater portion of animal matters, the ferment of the gastric juice, &c. The memoir shows in the most satisfactory manner that the dissolution of the fatty matter by the pancreatic juice is produced by the aid of this mysterious mechanism, and that its only agent is a ferment peculiar to the secretion of the pancreas. This new matter, whose peculiar character is to dissolve very rapidly fatty substances, may be obtained pure and preserved for some time without losing any of its efficacy.”

NEW MODE OF ARRESTING INFLAMMATION.

M. LATOUR recently communicated to the French Academy a paper, in which he endeavoured to prove that any inflammation manifesting itself on the skin may be arrested by covering the inflamed integuments with an adhesive compound capable of entirely preventing the access of atmospheric air. He had used gum for covering the parts, but now used collodium. Two cases of erysipelas were mentioned, which were thus cured in a few days.

SECRETION OF MILK.

M. LAMPERIERRE has exhibited to the French Academy an instrument constructed by him, of India-rubber, — an artificial mouth, as it may be called, — with a view to ascertain and determine the quantity of milk secretion in the female breast. It is made to embrace the nipple closely, and is provided with apparatus to rarefy or exhaust the air so as to produce a vacuum. The conclusion to which the inventor

arrives, after sixty-seven experiments, is, that the secretion in each breast every two hours is from one and a half to two ounces. He met with one instance in which the quantity amounted to nearly three pounds in twenty-four hours.

RESEMBLANCE BETWEEN THE FACES OF MEN AND ANIMALS.

At the meeting of the American Association, in August, Prof. Agassiz made an oral communication on the comparisons which may be drawn between the faces of men and those of fishes and other Vertebrata; the main points stated are embraced in the following abstract: — We hear frequent remarks in regard to the resemblance existing between the human face and the appearance of different families of animals. People are sometimes impressed with recollections of some friend by looking at pictures of animals. But as soon as we ask in what the resemblance consists, we are at a loss for an answer. By observing different races of mankind, he had been led to investigate these appearances, together with the differences existing in the human race. The unity of structure existing between all classes of Vertebrata is proof positive of a resemblance between individuals of this great class. From the lowest type of vertebrates up to man, one common structure of frame may be traced, and especially do we find such common structure of the face in general. The question is to determine the gradation of species, and the moral and physical superiority of individuals. He opposed Camper's theory of the facial angle, showing its failure to explain the various differences which exist. The effect of many of its principles, indeed, would place some families of animals above the human race. The Professor also traced, by diagrams, the resemblance between the bones of people in old age and the folds of the jaws in fishes. Whiskers and mustachios on mankind he considered as very closely related to the hairs on the face of the monkeys. He urged the importance of accurate portraits of monkeys, and other animals, akin to mankind, in order better to determine the relative position of the parts, and the connections which exist between individual beings. In conclusion, he showed that, by extending the line of the human features, a resemblance may be at once traced to different individuals of the animal kingdom.

INCREASE OF THE NAIL AND THE HAIR IN MAN.

THE growth of the nails is more rapid in children than in adults, and slowest in the aged. It goes on more promptly in summer than in winter, so that the same nail which is renewed in 132 days in winter requires only 116 in summer, — a fact depending on the *vis vitalis*, which seems to be proportional to it. The increase for the nails of the right hand is more rapid than for the left; moreover, it differs for the different fingers, and in order corresponding with the length of the finger; consequently, it is most rapid for the middle finger, nearly equal for the two either side of this, slower for the little finger, and slowest for the thumb. For the middle finger of the right

hand the nail grew 12 millimetres in 108 days; for the small finger of the left, 9 millimetres in 152 days; the growth of all the nails of the left hand required 82 days more than for those of the right, and also there were produced in this time 3 millimetres less than on the right hand.

The growth of the hair is well known to be much accelerated by frequent cutting. It forms more rapidly in the day than at night, and in hot seasons than in cold. But it is difficult to determine the precise rates. The growth of the hair and nails, as well as the epidermis, pertains to the secretions, and not to the organic structure proper; for the quantity of each formed corresponds very nearly with that of the peripheric secretions, especially with transpiration, it increasing in the summer, whilst, on the contrary, the growth and nutrition of the body are most rapid in winter, so that the weight of man, as observed by Sanctorius and others, is greatest in winter; the small growth of the hair during the night accords with the fact of the diminution of all the secretions, as with that of transpiration, the formation of carbonic acid, the urinary, lacteal, and biliary secretions. — *L'Institut*, No. 846; *Silliman's Journal*, July.

HAIR OF DIFFERENT RACES OF MEN.

Mr. P. A. Brown, of Philadelphia, has communicated to the American Ethnological Society an essay entitled "the classification of mankind by the hair and wool of their heads," with an answer to Dr. Pritchard's assertion that the covering of the head of the negro is hair, properly so termed, and not wool. The author of this paper states that, on microscopic examination, there appear to be three prevailing forms of the transverse section of the filament, viz. the cylindrical, the oval, and eccentrically elliptical. There are also three directions in which it pierces the epidermis, and is prolonged to its apex. The straight and lank, the flowing or curled, and the crisped or frizzled, differ respectively as to the angle which the filament forms with the skin on leaving it. While the cylindrical and oval pile has an oblique angle of inclination, the eccentrically elliptical pierces the epidermis at right angles, and lies in the dermis perpendicularly. The hair of the white man is oval; that of the Choctaw, and some other American Indians, is cylindrical; that of the negro is eccentrically elliptical or flat. The hair of the white man, besides its cortex and intermediate fibres, has a central canal, which contains the coloring matter when present. The wool of the negro has no central canal, and the coloring matter is diffused when present, either throughout the cortex, or the intermediate fibres. Hair, according to these observations, is more complex than wool. In hair the enveloping scales are comparatively few, with smooth surfaces, rounded at their points, and closely embracing the shaft; in wool, they are numerous, rough, sharp-pointed, and project from the shaft. Hence, the hair of the white man will not felt; the wool of the negro will.

AMERICAN CRANIA.

AT the Boston Natural History Society, April 17, the President, Dr. Warren, exhibited a number of American crania, and pointed out the difference between those of races quite distinct in geographical position. He compared a Mexican head of primitive race with one of a North American Indian, showing as great a similarity between them as is usually seen between the crania of Indians of the same tribe. A cranium of one of the second of the Mexican races, the Toltec, was shown, in comparison with the crania of three Mound Indians and an Inca Peruvian, to resemble them all very closely, giving probability to the opinion that they were all originally of the same stock, the Mound Indians by migration having founded the Toltec race, and they, in turn, the Inca. He also exhibited one of the elongated crania of the Peruvian race which preceded the Incas; also an Aztec cranium belonging to the race which followed the Toltecan in Mexico, remarkable for its antero-posterior compression, and a deep perpendicular depression behind, extending up over the vertex, dividing the head into two lateral lobes. A cranium of a Natchez Indian was shown to resemble this last very closely, particularly in the flattening from before backwards. — *Proceedings of the Natural History Society.*

PECULIARITIES OF AFRICAN CRANIA.

DR. NEIL mentions two peculiarities more or less completely characteristic of the African skull. One is the division of the articulating surface of the occipital condyle into two faces by a transverse ridge or groove. The two faces are sufficiently rounded off in some cases to give the outline of the figure 8, instead of an oval. An examination of the skulls in the extensive collection of Dr. Morton, of Philadelphia, showed that this mark existed in 30 out of 81 African crania, in only 4 pure Egyptian heads, and in 3 out of 105 heads of aboriginal Americans, but in none out of 129 skulls of other nations. The occasional existence of this mark has been previously noticed, but Dr. Neil has first pointed out its rarity in other than African crania. He suggests that this transverse mark represents the fissure which in the fœtus separates the basi-occipital bone from the next piece of the occiput on each side. This fact, if it holds generally, may be considered an illustration of the law thus propounded by Agassiz: — "In the different formations through which animals pass, from the first formation in the embryo up to the full-grown condition, may be found a natural scale, by which to measure and estimate the position to ascribe to any animals." Thus, the persistence of a fœtal stage of formation would mark the race to which it was peculiar as a lower variety of the species. Another fœtal peculiarity persistent in the African head is the absence of a sharp edge at the lower boundary of the anterior nares, running from the anterior edge of the nasal process to the anterior nasal spine. — *American Journal of Medical Sciences, Jan.*

SIZE OF THE BRAIN IN VARIOUS RACES AND FAMILIES OF MAN.

IN *Silliman's Journal* for April, we find a valuable series of observations on the size of the brain in different families of man, being the results of internal measurements of 623 human crania, by Dr. S. G. Morton, of Philadelphia. The measurements were taken by means of leaden shot, one eighth of an inch in diameter, which give, with great exactness, the absolute capacity of the cranium, or bulk of the brain, in cubic inches. Among the facts elicited by this investigation are the following:—1. The Teutonic or German race, embracing, as it does, the Anglo-Saxons, Anglo-Americans, Anglo-Irish, &c., possess *the largest brain of any people*. 2. The nations having the *smallest heads* are the ancient Peruvians and Australians. 3. The barbarous tribes of America possess a much larger brain than the semi-civilized Peruvians or Mexicans. 4. The ancient Egyptians have the least-sized brain of any Caucasian nation, excepting the Hindoos. 5. The negro brain is nine cubic inches less than the Teutonic, and three cubic inches larger than the ancient Egyptian. 6. The largest brain in the series is that of a Dutch gentleman, and gives 114 cubic inches; the smallest head is an old Peruvian, of 58 cubic inches; the difference between these two extremes is no less than 56 cubic inches. 7. The brain of the Australian and Hottentot falls far below the negro, and measures precisely the same as the ancient Peruvian. This extended series of measurements fully confirms the fact previously set forth by Mr. Morton, in his works, that the various artificial modes of *distorting the cranium* occasion no diminution of its internal capacity, and consequently do not affect the size of the brain.

SPONTANEOUS COMBUSTION OF A HUMAN BEING.

THE *Paris Gazette des Tribunaux* of Feb. 25 states that a house-painter, while drinking with some companions in an inn near the Barrière de l'Etoile, made a wager that he would eat a lighted candle. Scarcely had he placed it in his mouth, when he uttered a slight cry, and a bluish flame was seen upon his lips. In spite of all attempts to aid him, the internal fire continued, and in half an hour the head and upper portion of the chest were entirely carbonized. The fire did not cease till bones, skin, and muscles were all consumed, and nothing remained but a small heap of ashes to mark the spot where a human being had stood a short time before.

DEATH FROM WANT OF SLEEP.

A MR. LYNTON has lately made a communication to the Asiatic Society of London, descriptive of a mode of punishment peculiar to the criminal code of China. A Chinese merchant, named Hiam-ly, accused and convicted of having killed his wife, was sentenced to die by the total deprivation of sleep. The execution took place at Amoy, in the month of June last. The condemned was placed in prison under the *surveillance* of three guardians, who relieved each other every alternate

hour, and who prevented him from taking any sleep, night or day. He lived thus for nineteen days, without having slept for a single minute. At the commencement of the eighth day his sufferings were so cruel, that he begged, as a great favor, that they would kill him by strangulation.

PRESERVATION OF LIFE AFTER THE LOSS OF A PORTION OF THE SPINAL MARROW.

M. BROWN-SEQUARD states, in a paper presented to the French Academy on June 24, that he has found by experiment, that, if death follows the destruction of portions of the spinal marrow, which are not essentially necessary to respiration, it is caused by the hemorrhage which follows, and not by the act of destruction. In proof of this he details some experiments upon pigeons, which show that with them life may continue for an indefinite time, certainly more than three months, after the destruction of a portion of the spinal marrow equal to half the length of this nervous centre. A comparison of two young pigeons of the same age, fed upon the same food, one of them being thus mutilated, shows that the weight and quality of the excrement is the same, as are the increase of weight and the length of the limbs, but the size of the leg, especially the thigh, is greater in the unharmed bird. All these facts tend to show that circulation, respiration, digestion, animal heat, urinary secretion, production of feathers, &c., are the same in both birds. This is also the case with adult pigeons, and, so far as has been examined, with many other birds.

ON THE GEOGRAPHICAL DISTRIBUTION OF HEALTH AND DISEASE.

SINCE the time of Hippocrates a belief has existed that the development of the moral and physical faculties of man is dependent, not on an original organization only, but also on the atmosphere by which he is surrounded, and the nature of the soil on which he is reared; and modern researches in physical geography, combined with statistical investigations in medical science, have confirmed this opinion. Sweden furnished the first tables of mortality; since then England, France, Prussia, and the United States have each contributed systematic statistical returns, and thus a vast mass of material has been accumulated, from which valuable conclusions may be deduced, especially since it is known that, during a similar series of years, the same diseases reappear with the most astonishing regularity, both as to periodicity and extent, and with reference to moral as well as physical causes. Endemic fever, including remittent and intermittent fever, prevails in North America, the West India Islands, on the west coast of Africa, in Syria, South Italy, the Ionian Islands, and in general the low, marshy districts of warm countries. Yellow-fever is endemic in North America and the West India Islands, between latitude 5° and 40° N., its northern limit in Europe being the latitude of Gibraltar. Diseases of the digestive organs are most prevalent in India, West and East Africa, England, Guiana, &c. Diseases of the liver greatly predomi-

nate in the East Indies, while consumption is most conspicuous in Great Britain, British North America, and Jamaica. Dropsy is most prevalent in West Africa, Great Britain, and Guiana. Among the different countries the most striking contrasts are sometimes exhibited; thus the West of Africa is the most fatal to Europeans, while the Southeast is the most healthy country on the globe. Although many causes besides that of climate contribute to produce these results, yet generally, both in countries and in cities, the chances of longevity are greatly in favor of northern latitudes. Of the former we find near the bottom of the scale, Java, as indicated by Batavia, some of the West India Islands, Sicily, Naples, &c.; and near the top, Norway, Sweden, and portions of England. In all cases cities are less healthy than rural districts; of these the lowest is Vienna, and the highest London. It appears that a cool climate near the sea is the most favorable situation for health and longevity. The causes of mortality not dependent on climate are chiefly poverty and want, bad ventilation, unhealthy or excessive labor, especially in youth, intemperance and dissolute habits, and war.

The proportion of deaths from consumption indicates how little mere climate has to do with the extent of this disease; since, while it is almost unknown in the Madras Presidency of India, it is more frequent at the Cape of Good Hope than in the Northern United States, nearly even in Britain and British North America, nearly the same at Gibraltar as in the West Indies generally, and is most fatal among European troops in Jamaica. Remittent fever shows an almost regularly progressive increase of temperature from the Northern States of America to Jamaica, where the deaths among Europeans amount to 10, and among the blacks to only 8 per 1,000. Of diseases of the digestive organs, in the United States the number of cases is 526, and deaths 14 per 1,000; while in Britain the cases are 95 per 1,000, and the deaths only 1 in 2,000 of the population. Rheumatism is most prominent in Britain and least so in Malta. In Asia it is least among Europeans in the Tenasserim provinces, India, and greatest in the Madras. The influence of climate is most powerfully evinced in the mental and physical degradation produced by malaria on the inhabitants of the moor and marshy districts of tropical regions; but, even in Europe, its effect on the amount of mortality is much greater than is generally understood. Thus, in the smiling plains of Southern Italy the rate of mortality is twice as great as in the cold region of Scandinavia; and this proportion appears to be held in all countries. Temperature alone has a great effect on the production of disease. It is calculated from the returns of mortality that a fall of the mean temperature of the air from 45° to 4° or 5° below zero destroys from 300 to 500 of the population of London.

In order to judge of the effects of a climate, it is necessary to compare the amount of mortality among the native population of a country with that of strangers to the soil. Now, we find that in all India the average amount of mortality among European troops is nearly three times as great as among natives, and that when in one locality 75 per cent. of European troops died, the mortality among the black troops

was little more than 2 per cent.; that the number of deaths from cholera in India is twice as great among Europeans as among natives. In Britain the number of deaths among the troops, generally, is 15 per 1,000 per annum, while among officers and the civil population it is only 9 per 1,000. In France the mortality among troops is 18 per 1,000, among civilians it is 10 per 1,000. In the island of Barbadoes the mortality among civilians is not more than 14 per 1,000, while among European troops it is 58 per 1,000. At the Cape of Good Hope, and in West Africa, the mortality among troops is 450 per 1,000, or 45 per cent.; in the navy at the same places it is only 25 per 1,000, or $2\frac{1}{2}$ per cent. In general the mortality among the sailors of the navy is much less than among the troops.

The effect of the means adopted for checking disease in England, France, and Germany, during the past century, are such that, while formerly 1 out of every 30 of the population died each year, now the average is 1 of 45, reducing by one half the number of deaths in these countries. In the year 1700, 1 out of every 25 of the population died in each year in England. In 1801 the proportion was 1 in 35; in 1811, 1 in 38; and in 1848, 1 in 45; so that the chances of life have nearly doubled, in England, within 80 years. In the middle of the last century the rate for Paris was 1 in 25, now it is 1 in 32. — *Keith Johnson before the British Association.*

DISEASES INCIDENT TO THE EMPLOYMENT OF PHOSPHORUS.

A COMMITTEE of the French Academy has assigned a prize of a thousand francs to a memoir of Drs. Bibra and Ghoist, of Nuremberg, on the dangers connected with certain manufactures in which *phosphoric* matters are employed. They offer these general remarks: — "The progress of industry, the changes in processes, have not been universally advantageous to man. Certain arts, doubtless, have been so improved as to render them less insalubrious; but, on the other hand, it has been seen that prejudicial incidents, or certain maladies, occur more frequently than of yore; and what is more remarkable, new maladies or new forms of disease are seen; thus the art of preparing phosphoric matches, which has been so widely diffused, has become the source of disease of the maxillary bones, both the upper and the lower, which affects a considerable portion of the persons employed in that manufacture. When it does not threaten life, it occasions the loss of the affected bone. This singular effect of phosphoric emanations was first observed in Germany, and there Dr. Roux studied it when it had not been yet noted in France. There is, besides, a curious circumstance, that females are more subject to it than men, and young women more than those advanced in age."

This disease of the jaw, *necrosis*, is quite common in lucifer match-factories on the continent of Europe. The explanation of it is by no means difficult. The phosphate of lime as it exists in the bones is insoluble in water, but by the arrival of an additional quantity of phosphoric acid, which being present in the air is absorbed, and penetrates into the bones, the basic phosphate of the bones is converted

into an acid phosphate, which is very soluble in water, and even deliquescent in the air. In this way the bone loses its consistency, becomes inflamed, suppurates, and falls into a state of *necrosis*. As the disease always commences where there are carious teeth, the transformation takes place directly; the vapors coming in contact with these teeth, first affect them, and then the jaw with which they are in connection.

GOITRE AND CRETINISM.

THE commissioners appointed by the King of Sardinia to ascertain the amount of cretinism in that kingdom have published some interesting returns, which throw considerable light on the nature of that disease. The report defines cretinism as always accompanied by cerebral defect, with a mal-formation of the cranium, a small amount of muscular energy, impotence, and idiotism to a greater or less degree. The result of very extensive observation tends to prove that cretinism is not directly connected with goitre; as there is a large proportion of the population of the Alpine Sardinian States afflicted by goitres who have no taint of cretinism. Endemic cretinism is confined in Sardinia to the valleys and plains belonging to the loftiest Alpine elevations, having for their centre the three culminating points of Monte Viso, Mont Blanc, and Monte Rosa. The valleys where the disease is most prevalent are the deepest, the most confined, the dampest, and those possessing the smallest circulation of air and the least amount of light. The largest proportion of cretins was always found in the most wretched hovels, apart from other habitations, and often near marshy ground, and surrounded by trees. In towns and large villages, the cretins were not found spread over the various quarters, but only in those localities farthest removed from commerce and civilization. Taking the population of the Sardinian States at 2,651,106, the following figures show the number of persons afflicted with goitre and cretinism.

Goitres.		Cretins without Goitres.	
Men,	4,323	Men,	1,120
Women,	5,236	Women,	891
Sex not specified,	12,282		2,011
Total,	21,841	Cretins with Goitres.	
		Men,	1,953
		Women,	1,959
		Sex not specified,	1,161
			5,073
		Total number of cretins,	
		7,084	

Relatively to the intensity of the disease, the cretins were thus subdivided:—

Bereft of all reasoning powers, 2,165. Enjoying some power of speech, but with intellectual powers limited to their bodily wants, 3,518. With less imperfect intellectual powers, and capable of being taught trades, 424. Unclassed, 980. Total, 7,087.

Thus the number of cretins is 0.27 per cent. of the whole population, and of goitres 0.82. The opinion of Saussure, that cretinism does not exist more than 3,280 feet above the sea, is unfounded, as numerous cases were found at a height of 5,248 feet. — *London Athenæum*, July.

The following additional facts drawn from the same report, we extract from the *Medico-Chirurgical Review*, for October: — The cretin is unable to walk until the sixth or seventh year. It is about the seventh year that the disease becomes really developed. There seems to be no intermediate age between childhood and puberty (usually about 20), or between puberty and old age. In the adult state the stature rarely exceeds 1½ metres, and a great number of individuals examined did not reach 0.975 metres. The feet are too large for the body, the head large and pendent, the chest too small, and a protuberant belly is supported by wasted legs. The head is almost always misshapen. The eyes are distorted by convergent strabismus, and are without the slightest expression. The mouth is large, with swollen lips. The tongue, too, is of large size. The sexual organs are, in some cretins of enormous size, and in others atrophied. In proportion to the degree of imbecility, the respiration and circulation are slower, and the temperature reduced. True cretins do not possess the power of reproduction, but semi-cretins occasionally do. Blind cretins are rare. Hearing is defective, and true cretins seem to be destitute of smell or taste, while touch is little developed. They are very indifferent to extremes of heat and cold. The voice resembles the howling of an animal. More or less imbecility is a constant characteristic, and exists in proportion to the intensity of the disease. They rarely live beyond 40 years, and then only under favorable circumstances. In fact, the duration of life seems to be from twenty to forty years, the maximum relating to incomplete, and the minimum to complete cretinism. It is rare to find a family in which it prevails reaching the fifth generation.

CURE FOR STAMMERING.

At the Boston Society of Natural History in February, Dr. Warren alluded to a simple, easy, and effectual cure for stammering, which is known to be generally a mental, and not a physical defect. It is, simply, at every syllable pronounced, to tap at the same time with the finger; by so doing, the most inveterate stammerer will be surprised to find that he can pronounce quite fluently, and by long and constant practice he will pronounce perfectly well. This may be explained in two ways, either by a sympathetic consentaneous action of the nerves of voluntary motion in the finger and in those of the tongue, which is the most probable; we know, as Dr. Gould remarked, that a stammerer, who cannot speak a sentence in the usual way, can articulate perfectly well when he introduces a rhythmical movement, and sing it; or it may be that the movement of the finger distracts the attention of the individual from his speech, and allows a free action of the nerves concerned in articulation.

ASTRONOMY AND METEOROLOGY.

NEW PLANETS DISCOVERED IN 1850.

M. DE GASPARIS, the discoverer of Hygea,* discovered at Naples, on May 11, a new telescopic planet, making the eleventh asteroid, to which he has given the name *Parthenope*. It is a star of the ninth magnitude, and at the time of its discovery was very nearly in opposition. Dr. Galle first detected it in Germany, and since the first announcement, very numerous observations have been made both in Europe and America, but especially at Washington. It occupies no extreme place in any one of its elements. The mean motion is between that of Astræa and that of Hebe. The emblem for Parthenope is a star and fish.

Mr. W. C. Bond, in a letter to the *Boston Traveller*, states that Mr. Hind, Secretary of the Royal Astronomical Society in London, discovered a new planet on the 13th of September. Mr. Hartnup, of Liverpool, detected it on the 17th, and it was observed at Altona, by Petersen, on the 25th and 30th, at Berlin on the 21st, and at other places in Europe and in this country at various times since. Mr. Hind, in a letter of Oct. 2d, thinks "the period of revolution of the new planet will be nearly the same as that of Iris, perhaps a little longer." But Dr. B. A. Gould, Jr., from a calculation from some of the earlier observations, comes to the conclusion that, if the elements obtained are worthy of reliance, the period of the new planet "is shorter than that of any other asteroid, with the single exception of Flora." This forms the twelfth of the group of ultra-zodiacal planets. Mr. Hind proposes *Victoria* as its name, and a star surmounted by a laurel branch as its symbol. This name has been adopted by the Astronomers Royal of England, Prussia, and Denmark, but being at variance with established usage, is objected to by some astronomers in this country, who, to avoid all misapprehension, prefer the other name proposed by Mr. Hind, *Clio*, for which the same symbol would answer, and Mr. Hind has acquiesced in this preference.

* See *Annual of Scientific Discovery*, 1850, p. 341.

A third new planet was discovered by Gasparis, at Naples, on Nov. 2, resembling a star of the 9.10 magnitude. Prof. Schumacher announces the discovery, in a circular dated Nov. 14, and states that Gasparis detected it by means of the zones in the vicinity of the ecliptic, which he had constructed to aid him in his search for planets. Dr. Petersen estimates it as of the 10 magnitude. The new planet has been named *Egeria* by Leverrier, at the request of Gasparis.

THIRD RING OF SATURN.

THE MESSRS. Bond, of the Cambridge Observatory, have at length succeeded in establishing the existence of a third ring around the planet Saturn, which has been for some time suspected. It is within the inner edge of the other rings, and is not, as some have supposed, a subdivision of the old ring, like those described by Encke and others. The light reflected from its surface is so feeble as to cause its projection on the globe to appear like a very narrow dark line across the disk. It will be remembered, that the eighth satellite of Saturn was discovered by Mr. Bond about two years since. A detailed account of the new discovery, illustrated by drawings, is now preparing, but some months must necessarily elapse before it can be published.—*Editors.*

DISCOVERY OF A SECOND SATELLITE OF NEPTUNE.

THE following extract of a letter from Mr. Lassell to the Astronomer Royal, dated August 14, is printed in a late number of the Proceedings of the Royal Astronomical Society:—"I have strong reason to suspect that I have to-night detected a second satellite of Neptune. Last night, the 13th, at about eleven o'clock, I observed the satellite of Neptune for the first time this season, and made a diagram of it, the satellite being towards its southern elongation. The sky was extremely unfavorable; and finding that no measures of either position or distance could be taken with any chance of accuracy, I attempted none. To-night, in a somewhat better, but still bad sky, I see what I conceive to be another satellite, in the line of northern elongation of the old satellite, and about two diameters distant. This cannot well be the satellite already known, which ought to be almost preceding the planet; and in that position is generally invisible. There can be no question of the reality of the observations, the satellite of to-night (considerably fainter than that of last night) being repeatedly and almost constantly seen with various powers, e. g. 316, 479, 628. The position of the satellite is, as I have said, very nearly in the direction of the greatest northern elongation of the old one, and, being barely two diameters of the planet distant, may probably be inferior to it. The sky became cloudy shortly after eleven, and remained so, which prevented any confirmatory observations of motion. But I think the hypothesis of a fixed star of a similar magnitude and in the precise direction being located there, is too unlikely to throw much doubt upon the discovery."

Other astronomers have before conceived that they have detected a second satellite of Neptune, but have been deceived, and no other notice of the above having been published, it is probable that Mr. Lassell was mistaken. — *Editors.*

OBSERVATIONS OF NEPTUNE BEFORE ITS DISCOVERY AS A PLANET.

DR. PETERSEN writes to the *Astronomical Journal*, No. 6, that Dr. Lamont has twice recorded the planet Neptune as a fixed star, in his zones. The first time was October 25, 1845, when he estimated it as of the ninth magnitude; he observed its transit over the middle thread at $21^{\text{h}} 42^{\text{m}} 43^{\text{s}}.1$; the second time was September 7, 1846, when it crossed the second thread at $21^{\text{h}} 54^{\text{m}} 24^{\text{s}}.9$, and was entered as of the eighth magnitude.

SPOTS IN JUPITER.

PROF. SCHUMACHER, in a letter in the *Astronomical Journal*, No. 10, states that Mr. Lassell, on March 27, with his twenty-foot refractor (twenty-four inches' aperture and a magnifying power of 430), observed four or five remarkable white spots in the belt directly above the middle belt on Jupiter's disk. "The principal spot is exactly half way over at 11h. (Greenwich M. T.) They are all perfectly round, distinct, and bright. The largest is as plain as I have seen with the nine-foot telescope the disk of a satellite just entered within the limb, and as well defined. They keep their relative positions as they are carried along by Jupiter's rotation; and there are no other similar spots anywhere on the disk."

The announcement to the Royal Astronomical Society of London makes the number of spots six.

COMETS OF 1850.

DURING the year 1850, several comets have been discovered. The first one, known as Petersen's comet, was first discovered by Dr. Petersen, at the Altona Observatory, on May 1. After the first announcement in the *Astronomische Nachrichten*, observations were multiplied with great rapidity, both before and after it became visible to the naked eye. From its first appearance, as seen at Cambridge through the great refractor, it presented a bright stellar point in its centre. On July 10, a tail of 4° or 5° was visible in the comet-seeker, with an evident curvature, the convexity presented to the zenith. This comet was discovered near the north pole, and disappeared near the south pole. Its minimum distance from the earth was about thirty-eight millions of miles. The first European observations were represented by elements which made the probability of a collision with our planet a matter of serious apprehension, but subsequent observations disclosed their error.

Mr. George P. Bond, of the Cambridge Observatory, discovered a

comet on the evening of August 29, in the constellation Camelopardalus. It then, in the great refractor, presented a very feeble concentration of light towards the centre. It was also observed at Cambridge on the 30th and 31st, and on September 2, 3, and 8, and frequently after the latter date. The comet was discovered in Europe at four localities, independently of each other, and before the announcement of its discovery in this country; but Mr. Bond has the honor of the priority. It was detected by Mr. Brorsen, at Senftenberg, on Sept. 5; by Mr. Charles Robertson, at Markree Castle, Ireland, on Sept. 9; by Mr. Clausen, in Dorpat, on Sept. 11; and at one other locality, we presume, as Schumacher speaks of five discoverers. It had no nucleus.

The *Boston Traveller* states that Mr. Bond, of the Cambridge Observatory, on the evening of Jan. 1, 1851, while sweeping with the great refractor, discovered a very faint nebulosity, so faint that it could not be seen through a four-foot telescope.

This comet is supposed to be the same as that seen by M. Faye, Nov. 22, 1843, as the calculations of Nicolai and Leverrier assigned to it a period of 2717.68 days, with an eccentricity of 0.55596, and an inclination of its orbit to the ecliptic of $11^{\circ} 22' 31''$.

Leverrier read to the French Academy, on Dec. 9, a paper on Faye's comet, with especial reference to the probable action of Jupiter upon it. What was then in a great measure theory may now be perhaps tested by the fact. Leverrier, in 1844, assigned April, 1851, as the precise epoch of the return of Faye's comet to its perihelion.

This comet is, we believe, the eleventh seen at Cambridge before any information thereof had reached this country.

COMET DISCOVERED IN 1849 AT SEA.

LIEUT. MAURY communicates to the *National Intelligencer* an extract from a letter from Rev. Mr. Jenkins, of Georgetown College, who sailed for Rio de Janeiro in October, 1849, and states that he saw a comet during the voyage, "on November 15th, at $7\frac{1}{2}$ P. M. The nucleus was very distinct, and about as large in appearance as Mars; the tail was curved and pointed towards the south, was quite bright, and nearly a degree in length, as visible to the naked eye, but much larger when viewed with the spy-glass." A later account states that the ship was in lat. $13^{\circ} 22'$, long. $24^{\circ} 50'$ west of Greenwich. "The bearing of the comet from the ship was west-northwest; its course was southeast and northwest; height of head from the horizon, 48° ; in sight about one hour."

THE COMET OF 1264 AND 1556.

It is well known that in 1264 a great comet astonished the world, and is supposed to have returned in 1556. This period of about 292 years would have caused it to return in 1848. Since that period, therefore, a careful lookout has been kept for it, but it has not yet been detected. It is probable that Jupiter and Saturn may have by their influence retarded it for a considerable period.

Mr. J. H. Hind, in a letter to the *London Times*, states that Mr. J. T. Barber has made a calculation relating to the disturbances due chiefly to Jupiter's attraction during the last revolution. "He finds that between the years 1556 and 1592 the united attraction of Jupiter and Saturn would diminish the period 263 days, but that between 1592 and 1806 it would be increased by the action of Jupiter alone no less than 751 days, so that a retardation of 488 days must take place. How much longer Saturn, Uranus, and Neptune may detain it beyond this time we do not at present know, but the perturbations produced by the former planet up to 1806 are now in course of calculation by Mr. Barber, and on their completion, we shall probably be further enlightened in respect to the delay which has occurred in the comet's return. In these computations the elements which I deduced from the observations of Fabricius in 1556 have been employed. Now, if the major axis of the orbit in that year — on which the period depends — exactly corresponded to the interval between 1264 and 1556, the addition of 488 days to that interval would give the 1st of July, 1849, for the next arrival at perihelion; but as this is not likely to have been the case, and since, in our present ignorance of the exact length of the major axis in 1556, we may as fairly suppose it to have been longer as shorter than that deduced as above, it appears very possible that the comet may yet be several months, if not one or two years, before it makes its appearance, particularly if the effects of Saturn, Uranus, and Neptune, in the aphelion portion of the orbit, tend to retard it, as I believe they must do. The expected comet is distant from the sun, at its aphelion, more than 8,500,000,000 miles, or upwards of three times the mean distance of the newly-discovered planet Neptune, while in perihelion it approaches that luminary within the orbit of Venus."

M. Borné, of Middleburg, states to the Royal Institute of Science in the Netherlands, that he has completed two calculations with two sets of elements, those of Halley and of Hind, and finds from the former that the comet may be expected to appear on August 22, 1860, but by the latter an earlier period is indicated, August 2, 1858.

IDENTITY OF VARIOUS COMETS.

PROF. ALEXANDER, in a communication to the *Astronomical Journal*, No. 19, suggests the possibility of the various comets known as Encke's, the fourth of 1819, the third of 1819 (probably the same with the second of 1766), Vico's, Brorsen's, Biela's, and Faye's having "formerly constituted one, or at most two, whose orbit or orbits were contracted by the disturbing action of Jupiter, this action having been exerted at a time when the comets were thus combined. After this they may have been subdivided by a process as yet unknown, but similar to that by which Biela's was divided, almost under the eyes of the observers, at its last return, in 1846." This common origin is indicated by the near approximation of the semi-axes, the direct motion of all of them, the close grouping of similar nodes, the similarity of the inclination of the orbits thus grouped, and the actual division of Biela's comet.

After some remarks on some of the other comets, Prof. Alexander says, — “These facts and coincidences, in so far as they go, agree in indicating a near appulse, if not an actual collision, of Mars with a large comet in 1815 or 1816; that the comet was thereby broken into three parts, whose orbits (it may be) received even their present form; viz. that still presented by the comets of 1812, 1815, and 1846, IV., which are fragments of the dissevered comet.”

THE METEOR OF SEPTEMBER 30.

A METEOR of a remarkable character and unusual brilliancy was observed at the Cambridge Observatory on the evening of Sept. 30, and has been described by Mr. W. C. Bond in the *Boston Traveller*. He says, — “My attention was called to this phenomenon by Miss Jenny Lind, who, happening at the time of its first appearance to be looking at the planet Saturn through the great equatorial telescope, nearly in the direction of the meteor’s path, was startled by a sudden flash of light, no doubt much concentrated by the power of the glass; probably not more than a second of time intervened before the meteor exploded, leaving a bright train of light some eight degrees long, extending from near the Head of Medusa towards a point three degrees below the star Alpha Arietis, this being the direction of motion, and projecting a portion of its mass forward about two degrees. This took place at 8h. 54m. m. s. t. of the Observatory, and in or very near the small constellation ‘Musca Borealis,’ in right ascension 2h. 30m. and north declination 27 degrees. There were numerous radiations, but nothing sparkling in its appearance. At 8h. 57m. this had subsided into a serpentine figure about half a degree broad in the widest part and ten degrees long. At 9 o’clock the preceding portion had extended upward, or, as expressed by a person who noticed the same appearance at Framingham, it appeared ‘to draw up its head like a serpent.’

“During these changes, the meteor had continued a bright, conspicuous object, some ten degrees in length, lying nearly horizontal. It was examined with three different telescopes, — the comet-seeker, a four-foot refractor, and the great equatorial. The appearance was that of a congregation of minute, bright clouds, of the formation usually denominated cirro-cumuli. At 9h. 7m. we had the regular cometary figure [the curved part had separated from the straight, and formed a sort of oblong semicircle surrounding the end of the straight portion]. This, the most durable form, forcibly reminded me of the drawings made by Sir John Herschel of Halley’s comet, as seen by him at the Cape of Good Hope, on the 28th of January, 1836.

“The meteor now commenced a slow, regular motion, passing about a degree below the star Alpha Arietis, towards a point somewhat above the planet Saturn, at the same time *rotating* apparently on a point answering to the nucleus of the explosion, and expanding in every direction. At 9h. 28m. the external outline of the circular portion was in contact with Saturn. The meteor was now extended in breadth to twelve degrees, its longest diameter reaching upwards nearly to the zenith. Its *rotary* motion had therefore been equal to an angle of

about 90 degrees in twenty minutes of time. Although it had now become a faint nebulous light, yet it continued to exhibit a well-defined boundary until past ten o'clock, having been under observation more than an hour; I have never met with any account of a single meteor having been visible for so long a time.

"From the observations communicated by the Hon. William Mitchell, of Nantucket, combined with our own, we have ascertained that the vertical height of this meteor above the surface of the earth was about fifty miles, and its distance from Cambridge one hundred miles in a northeastern direction. We have accounts of its having been seen from near Albany, Brooklyn, Providence, Nantucket, Manchester, Cape Ann, Portland, Boscawen, Plymouth, and Peterboro', N. H., Quebec, on the St. Lawrence, and the interior stations, Springfield, Framingham, and Lancaster, Mass., and Norwich, Conn., as well as on Long Island Sound." It was also seen in South Deerfield and Littleton, N. H.

BRILLIANT METEOR.

A most brilliant and remarkable meteor, yielding light sufficient to illuminate every place situated within the distance of two hundred miles of it, was seen in the South of England on the night of February 11. Mr. Glaisher, of the Royal Observatory, Greenwich, has deduced the following results respecting it, from a large number of observations made in different parts of the country. The meteor first made its appearance in a position 8° or 9° W. of N. and at an estimated distance of 84 miles from the earth. During the first part of its progress it very rapidly descended obliquely towards the earth, in such a manner, that at first it was between 80 and 90 miles from the earth, and less than 50 miles distant within 4 seconds afterwards, the two places over which it was vertical at these times being separated by about 17 miles; it then descended less rapidly, until, when over a locality 110 miles from the place of first observation, its distance from the earth being 19 miles, it exploded, with a sound like thunder, and sufficiently loud to be noticed at places at a distance exceeding 50 miles. After the explosion, the luminous fragments into which it separated were seen until within ten miles of the earth. From the most careful and moderate calculations, Mr. Glaisher considers the diameter of the meteor to have been from 1,800 to 2,000 feet. Its light was so brilliant, that some persons compared it to strong sunlight, and even at places where the sky was covered with thick clouds, the light was so strong as to fully illuminate every object. From the time of its first appearance to the time of its explosion an interval elapsed of about 11 seconds. In conclusion Mr. Glaisher observes, — "The report accompanying the explosion of this body was so great, that I am inclined to believe that its substance was of a firm texture, broken into many pieces by the extraordinary expansion of an elastic fluid. It seems also certain, that it must have come from the regions of space far beyond the influence of our vapors; and this fact, together with its extreme velocity and the intensity of the light, are circumstances more conformable to a solid than to a gaseous substance." — *Brewster's Magazine*.

PERIODIC METEORS IN 1849.

M. COULVIER GRAVIER, in a paper presented to the French Academy on Dec. 10, 1849, states that his observations upon the meteors of the 12th and 13th of November do not agree with Prof. Olmsted's theory of their periodical appearance and radiation. It is known that these meteors, radiating from a point in the Lion, cannot appear before the rising of that constellation, and Prof. Olmsted affirms that no shooting star shows itself before midnight, when some large meteor seems to give the signal for their periodical appearance. M. Gravier's own observations have shown this not to be the case, and his view has been confirmed by observations made at Breslau, where numerous meteors appeared before midnight, so that we must either deny the radiation in question, or consider as strangers to the periodical return the 88 meteors of the 12th of November, and the 69 of the following day. "It is to be regretted that observations were not made in Silesia before and after that period, for there would have been found an increasing scale till the 16th of October, followed by a descending one which has not yet ceased. The numbers observed at Breslau would, doubtless, have been proportional to ours. We give here the means of several days."

Mean Dates.	Hourly Mean.	Mean Dates.	Hourly Mean.
July 23,	8 stars.	Oct. 8,	30 stars.
" 24,	21 "	" 16,	40 "
Aug. 7,	55 "	" 21,	31 "
" 10,	106 "	" 29,	25 "
" 14,	60 "	Nov. 7,	16 "
" 20,	21 "	" 14,	13 "
Sept. 7,	20 "	" 22,	12 "
" 15,	20 "	Dec. 5,	21 "
" 24,	15 "		

It will thus be seen that the hourly numbers of the 12th and 13th of November are smaller than those of any preceding day since July. The observations for the preceding years furnish other proofs of the change of the maximum of November. From a table given it appears that the hourly number of shooting stars seen on the 12th and 13th of November has gradually decreased from 100 in 1833 to 14 in 1848, and 17 in 1849. The change has not, however, been wholly regular; thus in 1844 the number was 20; in 1845, 35; and in 1846, 13; but yet on the whole there is an evident decrease since 1833. It will soon be ascertained whether this decrease, continuing through seventeen years, will be followed by an increase for the same period.

PERIODIC METEORS FOR 1850.

OBSERVATIONS made at different points during the past year show that the meteors have again proved true to their established periods. On the evening of the 9th of August, three observers at New Haven counted in $2\frac{1}{2}$ hours (from 12h. 40m. to 3h.) 451 meteors. They

appeared, as has been heretofore observed, to proceed directly from the space situated a little below Cassiopœia's Chair, or to move in lines of direction which, if continued back, would pass through that space. Many of the meteors observed were followed by trains of momentary duration, but none were seen of extraordinary size or brilliancy, and some were mere luminous points, which darted with excessive velocity. During a part of the time in which the observations were made, an aurora of moderate intensity was visible. On the 10th of August three observers counted 312 shooting stars between 10h. and 12h., and between midnight and 3 A. M., 351 different meteors were noted, although many were lost by an intermission of about an hour on the part of one of the observers.

Numerous meteors were also noticed at the Cambridge Observatory on the evenings of August 9th and 10th, the majority of which might be traced as radiating from a point midway between Cassiopœia and the pole. An aurora was also visible on the evening of the 10th.

According to a report made by M. Angles to the French Academy, great numbers of meteors were observed, on the night of the 10th, near Roanne, France. From 9 P. M. until 2½ A. M., the sky being clear, nearly 400 were observed, although the observations did not embrace one fifth of the heavens. Their general direction was northerly.

As has been the case for some years past, the meteoric visitation of Nov. 13 seems to have failed, although the weather was generally unfavorable so as to prevent good observations. In fifteen minutes on the morning of that day, however, only three or four meteors were seen, although it was quite clear.

METEOR OF AUGUST 19, 1847.

M. PETIT, Director of the Observatory of Toulouse, has communicated to the Academy of Sciences of that city a memoir on the determination of the orbits of meteors, not only relatively with respect to the earth, but absolutely with reference to the sun. This memoir contains formulæ applicable to all cases where observations thoroughly to be depended on are procured. The meteor of August 19, 1847, afforded such observations, and in a letter published in the *Astronomische Nachrichten*, No. 701, M. Petit states the following extraordinary result of his calculations. The meteor, when first seen, was at a distance from the earth's surface of 217,900 metres, and when last in sight, of 68,900. Its relative velocity with respect to the earth was 41,700 metres per second, and its absolute velocity in its orbit about the sun, 70,094. At the moment of its first apparition, it was in the act of describing a hyperbolic orbit about the sun, having for its perihelion distance 0.9783952, and a semi-axis of -0.2385498 . But since at that instant it had already undergone some effect of perturbation, both by the earth and moon, allowing for this, M. Petit concludes, that, previous to entering the sphere of the earth's appreciable action, its orbit was hyperbolic, with an eccentricity 3.95134, perihelion distance 0.95626, and semi-axis -0.32401 . This meteor, therefore, must have come from the regions of space exterior to our system.

and the epoch at which it must have quitted a sphere having a radius of one parallactic unit (or the distance of a star whose annual parallax equals one second) must have been no less than 373,397.7 years antecedent to that of its arrival at its perihelion in 1847. This interesting body would appear, from M. Petit's calculations, to have fallen into the North Sea near the Belgian coast. — *Report of Council of London Astronomical Society.*

VARIOUS METEORS.

A LETTER from Mr. James Richardson, dated off Jerbah, Jan. 25, is published in the *Proceedings of the Royal Society*, in which he mentions an "astronomical phenomenon which terrified or arrested the attention of the inhabitants of the whole of this coast some two months ago. This was the fall of a shower of aerolites, with a brilliant stream of light accompanying them, and which extended from Tunis to Tripoli, some of the stones falling in the latter city. The fall of these aerolites was followed by the severest or coldest winter which the inhabitants of Tunis and Tripoli have experienced for many years."

A brilliant meteor of the apparent size of the full moon was seen at Brooklyn, N. Y., on Nov. 24, at 5.35 P. M. It was in the west, and moved very slowly in a nearly horizontal line from north to south. It was of a fire-red color, and remained in sight while traversing a path of 70° in length.

A brilliant meteor was seen in the northern sky at New Haven, on June 16, while the sun was shining in full strength about an hour before its setting. It must have been of extraordinary brilliancy.

OCCULTATIONS OF STARS IN 1850.

MR. W. C. BOND, in a letter in the *Astronomical Journal*, No. 14, gives notices of the following occultations of stars observed at the Cambridge Observatory during the present year. Of Aldebaran on Jan. 23 and April 15, of Jupiter and his satellites on Feb. 26, and of Regulus. The occultation of Jupiter presented some interesting facts. At the immersion, one of the largest of the lunar mountains appeared projected upon the disk of the planet. A beautiful effect was produced at the emersion by the very narrow unilluminated strip of the moon's surface which was interposed between the planet and the bright border of the moon. The visible portions of the two bodies were within about $30''$ of each other, but separated by the intense blackness of the unilluminated edge of the moon, from behind which the planet and his satellites were emerging. The third satellite, as seen through the 23-foot equatorial, was more brilliant than usual, whilst the second appeared of a dull color and small. During its previous passage across the disk of Jupiter, this satellite was seen as a dusky elongation of its shadow, but as it ran along on a dark belt, it could not be distinctly recognized.

Mr. Mitchell, of Nantucket, in a notice of the occultation of Jupiter,

says, — "On the approach of the moon to the third satellite (the first occulted), it was perceived that the apparent course of the latter would be nearly parallel with the sloping side of a lunar mountain plainly visible on the outline of the moon's limb, rising by a gentle ascent from the north, and forming on the south the northern limit of a hollow equal in extent to the apparent diameter of Jupiter, into which, in his turn, he seemed to be plunged. In passing from the summit of the mountain to the bottom of the hollow, the point of its disappearance, the third satellite occupied two seconds of time, affording a novel means, in connection with the angle of the mountain's ascent, of determining the perpendicular height of the mountain above the general surface of the moon."

NEW STAR.

M. GUILLEN Y CALOMARDE has discovered a new telescopic star between the polar star and Cynosure, near the rise of the tail of the Little Bear; a star, at least, which did not exist in October, 1849. According to the observations of M. Calomarde, the new star should have an increasing brilliancy, and it is likely that, in less than a month, it may be seen with the naked eye. — *Harper's Magazine*, Nov.

THE COLORS OF STARS.

SOME five or six years since, Prof. Sestini, now of the Georgetown (D. C.) College, made in Rome a series of observations on the colors of stars, and he states in the *Astronomical Journal* that he has lately been engaged in comparing these colors as seen in Rome and in Georgetown, the same telescope being used in both cases, and to prevent deception he has always made the American observations before ascertaining from his memoir what color was observed in the Italian one. He says: — "The results are remarkably uniform; with a few exceptions, much more so than I anticipated. So that, were the state of the air to be ranked amongst the causes of the different colors of celestial objects, it seems to me that there is but little difference between this atmosphere and that of Italy, — even with regard to transparency." This conclusion is founded on various observations of the planets, as well as of the stars. It was, however, the single stars with which this uniformity was observed, for "the double stars were seldom found having the same colors." But besides the double stars, five out of the four hundred single ones reviewed are noticed as presenting remarkable differences. χ' Sagittarii was at Rome deep orange, at Georgetown light yellow; n Aquilæ, deep orange, and yellow; χ Serpentis, light yellow, and deep orange; θ Pegasi, white, and orange; γ Pegasi, purplish-blue, and white.

CHANGE IN THE PROPER MOTION OF α VIRGINIS.

MR. E. SCHUBERT, in a communication to the *Astronomical Journal*, No. 16, states that, in the course of an entirely new reduction made by

him for the Nautical Almanac of the Greenwich observations of Mars, he "was struck with the fact that the clock-errors given by *a Virginis* differed everywhere from those given by other fundamental stars, in such a manner that the right-ascension of that star given by the *Tabule Regiomontane* appeared to be too great." Consultation with Lieut. Davis and Prof. Peirce prompted him to pursue the matter further, and after he had, on account of some deviations in *a Canis Majoris*, concluded to omit that star from the number of comparison-stars, he was, upon mentioning to Prof. Peirce his supposition of a change in the proper motion of *a Virginis*, reminded that Bessel had made a precisely similar supposition in the case of the former star. After going into an elaborate investigation, Mr. Schubert says:—"In this table, then, the decrease of the differences until about the year 1783 is distinctly appreciable, as well as their increase afterwards in nearly the same ratio. This diminution of the differences up to the year 1783, and the subsequent decrease, correspond to an increase of the relative right-ascension, and to a subsequent decrease of it. I think it thus placed beyond all doubt that there are *variations in the proper motion of a Virginis*." Bessel has noticed a similar increase of the relative right-ascension of Sirius till 1794, where the difference is at its maximum, though he somewhat distrusts his result. This new case, however, confirms in a most striking manner the truth of that result. After some further investigations, Mr. Schubert concludes that the period for *a Virginis* is about 44 years, while Bessel's supposition of a period of 50 years for Sirius is confirmed.

"Bessel suspected that the stars which exhibit such irregularities move round dark bodies. Since the conviction has been forced upon me that such changes are common to all the fixed stars, although in most cases insignificant or included in long periods, I must venture to differ from Bessel's opinion, at least in some measure. There may exist peculiarities in the motion of the fixed stars in space which produce such variations in the proper motion, but which, together with their causes, we are not yet able to explain. A fixed star round which large and very distant planets are moving, admitting almost of being considered as revolving fixed stars, but invisible to us, will not itself move in the curve of the proper motion, but this curve will rather be described by the common centre of gravity."

In the *Astronomical Journal*, No. 18, Prof. Peirce examines this paper and its subject, and concludes as follows:—"On the whole, then, the weight of the argument appears to be in favor of the supposition that Spica is moving around some centre, which is not far distant from it."

THE PARALLAX OF GROOMBRIDGE 1,830.

STRUVE, in a paper presented to the French Academy on Jan. 28, gives the following as the result obtained from a long series of observations conducted with the most extraordinary care upon the parallax of the star Groombridge 1,830. "The parallax found equal to $+0''.034$ surpasses so little the probable error of $0''.029$, that it would

be rash to pretend that it furnishes us with an exact idea of the distance of the star Groombridge 1,830. But I consider it an indisputable result of my observations, that the parallax of this star is less than $0'.1$, for if it surpassed this quantity it could not have escaped me."

In the course of some remarks upon this paper, M. Faye observes: — "If the parallax of the star Argelander is $0''.034$, its velocity, calculated perpendicularly to a line joining our sun to the star is 251 leagues per second. Yet this enormous rapidity is only a minimum." He also presented a table, from which it appears that the calculated velocity of some of the stars is as follows.

Pole star,	$\frac{1}{2}$ league per second.	Arcturus,	22 leagues per second.
α Lyre,	2 " "	α Centauri,	5 " "
ϵ Ursæ Majoris,	7 " "	61 Cygni,	16 " "
Sirius,	6 " "		

The velocities deduced from the different parallaxes which have been assigned to Groombridge 1,830 are 8, 38, 47, and 251 leagues per second. A correction must be made to all these velocities, on account of the absolute motion of the sun and planets in space, of two leagues per second.

THE NEBULÆ.

At a late meeting of the Royal Society, the Earl of Rosse presented a communication detailing the results obtained by an examination of some of the nebulæ with his large telescope. It was accompanied by small sketches of some of them. He says they "are on a small scale, but are sufficient to convey a pretty accurate idea of the peculiarities of structure which have gradually become known. In many of the nebulæ they are very remarkable, and seem to indicate the presence of dynamical laws that we may perhaps fancy to be almost within our grasp." The spiral arrangement so strongly developed in H. 1622, 51 Mesier, is traceable more or less distinctly in several of the sketches. More frequently there is a nearer approach to a kind of irregular, interrupted, annular disposition of the luminous material, than to the regularity so striking in 51 Mesier; but it can scarcely be doubted that these nebulæ are systems of a similar nature, seen more or less perfectly, and variously placed with reference to the line of sight. The author considers that 3,239 and 2,370 of Herschel's "Southern Catalogue" are very probably objects of a similar character with the above. — *London Athenæum, July*

EXTRACTS FROM THE PROCEEDINGS OF THE LONDON ASTRONOMICAL SOCIETY.

MR. HIND says, "I discovered on the 4th of January last, a rather conspicuous nebula, the position of which for 1850 is, R. A. $12^h 0^m 33^s.16$, N. P. D. $23^\circ 59' 30''.1$. It is elliptical, and has a decided nuclear condensation.

"In October, 1845, I found a highly colored crimson, or even scar-

let, star in *Orion*, far the most deeply colored object I have yet seen. Its mean place for 1850 is, R. A. $4^h 52^m 45^s$, N. P. D. = $-15^\circ 2'$."

Mr. Fletcher says, in relation to Pollux, which Capt. Smith, in the *Celestial Cycle*, remarks has been suspected of varying in lustre, since it is recorded as having at times been brighter than Castor:—"At the moment I am writing, Pollux is obviously brighter than Castor, and I think it brighter than α Ursæ Majoris, at any rate, fully as bright."

Mr. G. S. Spreckley writes:—"On my voyage from Suez to Penang, my attention was excited by the unexpected splendor of η Argûs, which is now a large first magnitude, surpassing every other star in the constellation except Canopus. Seen with the naked eye, or with a glass, there was a manifest difference in color between the rays of light from its S. W. and from its N. E. position, the former being brilliant red, and the latter bluish-green. Is it a double star?"

SPRING-GOVERNOR.

AT the meeting of the American Association, at New Haven, a new machine was exhibited, designed for producing uniform continuous motion, for which the name of the Spring-Governor has been proposed. The apparatus was invented by the Messrs. Bond, of Cambridge. It consists of a train of wheels communicating with a fly-wheel, intermediate between which and the motive power is a dead beat escapement, connected with a half-second pendulum. The connection between the escapement-wheel and the rest of the machinery is through a spring. The elasticity of the spring allows the motion of the circumference of the escapement-wheel to be arrested at every beat of the pendulum, while the rest of the train continues moving. By this means all changes in the motive power are effectually controlled, and a rotation perfectly continuous and uniform secured in the fly-wheel, so that the moving force may be increased without affecting its velocity. The principle may be applied to various forms and kinds of machinery. The design, in the present instance, was to secure an invariable motion to the recording surfaces employed in the electro-telegraphic operations of the Coast Survey. A clock of this description is to be constructed for the great equatorial of the Cambridge Observatory.

DOVE'S MAPS OF THE ISOTHERMAL LINES OF THE GLOBE.

PROF. DOVE has published some maps of the monthly isothermal lines of the globe, the object of which is to show the mean temperature, on Fahrenheit's scale, of every month in the year, at 900 stations on the globe. They have been constructed with great labor, on the basis of observations extending over a series of years. Among his results, the *London Athenæum* for July gives the following:—Dividing the globe at the meridian of Ferro, and computing the temperature of the parallels east and west of that meridian at every ten degrees of latitude, it is found (with the exception of the latitude of 70°) that the

eastern half, containing the largest mass of land, is colder than the western, the difference diminishing constantly as the equator is approached. Within the tropics the diminution of temperature in going northward is very regular. The average winter and summer temperature of the two hemispheres is shown by the following table :—

January.	Northern Hemisphere,	48.8 ^o
	Southern "	59.5
	The Globe,	54.15
July.	Northern Hemisphere,	71.0
	Southern "	53.6
	The Globe,	62.3

The temperature of the whole globe increases, therefore, fully 8° from January to July. The mean temperature of the globe is 58°.2', of the northern hemisphere 60°, and of the southern 56°.4'. In accounting for this, Prof. Dove says,—“The earth's surface being a highly varied one, the sun's influence upon it is also constantly varying, for the impinging solar heat is employed in raising the temperature of substances which do not change their condition of aggregation; but when engaged in causing the melting of ice or the evaporation of water, it becomes latent. When, therefore, the sun returning from its northern declination enters the southern signs, the increasing proportion of liquid surface upon which it shines causes a correspondent part of its heat to become latent, and hence arises the great periodical variation in the temperature of the whole globe which has been noticed.”

We shall now briefly consider the monthly isothermal lines. Taking the temperature of 32°, in January, the line drawn across the globe passes from Philadelphia over the Banks of Newfoundland, through the South of Iceland to the polar circle in the meridian of Brussels. Hence in the direction of the meridian to Holland, thence southeasterly to the Balkan; from the middle of the Black Sea it runs in a west and east course across Asia to the Corea, thence it rises to the Aleutian Islands, and descends again in America to the latitude of Palermo. In February the lines of equal temperature begin to move northward in Northern Asia, while in North America they are still moving southward. In March the spaces in America and Africa inclosed by the isothermal of 81½° F. have united. In April two spaces of unusually high temperature bounded by the isothermals of 86° F. are developed in the middle of Northern Africa and in the interior of Western India. Everywhere in Asia and Middle Europe, the isothermals are almost parallel with the parallels of latitude. The line of 32° F. still preserves its extraordinary bend, running from Cape Breton to the South of Greenland, through Iceland, thence to the North Cape, and sinks on the crest of the Scandinavian Alps down to the latitude of Drontheim, whence it bends eastward. This phenomenon is caused by the drift ice in the Atlantic, the effect of which is still more decided in May. From Nova Scotia to Newfoundland the isothermals are crowded more closely together. Mean-

while, the hot space in Africa, bounded by an isothermal of 86° , has extended and united itself with the hot space in Western India. In June this line has reacted in Europe up to Christiania. In the southern hemisphere the curves have become extremely flat. In July, the extreme temperatures manifest themselves. Within an elongated space, including Nubia and Southern Arabia, a line appears bearing a temperature of $90\frac{1}{2}$. But in Western India the temperature has also become extraordinarily high since May. In Europe the isothermals have overpassed the circular form, and begin to be convex in the interior of the continent. In August, in the old continent, the east side of Nova Zembla alone resists the still continuing tendency of the curves to become more convex, and hence they assume two characteristic convexities, one at Spitzbergen and the other at the mouth of the Lena. But on the coast of Greenland, as the drift ice decreases, the isothermal curves become flatter. In September this is the case in a still greater degree, and in Asia the convex summits are similarly flattened. This is, consequently, the month when the distribution of temperature over the globe is most regular. The isothermals of October show a decided invasion of cold from the north, and in November and December they become, in both continents, concave.

CLIMATE OF THE VALLEY OF THE NILE.

At the meeting of the British Association at Edinburgh, Mr. T. S. Wells communicated a paper on "the climate of the valley of the Nile," containing the results of observations made from December, 1849, to March, 1850. The mean temperature of the air for the period of observations was, at Greenwich, $39^{\circ} 3'$, on the Nile, 61° . The mean temperature of evaporation at Greenwich was $37^{\circ} 4'$, in Egypt 55° . The mean temperature of the dew-point at Greenwich was $34^{\circ} 1'$, in Egypt $50^{\circ} 8'$. The mean elastic force of vapor in Egypt was 0.384, at Greenwich 0.214. In other words, the pressure of the watery vapor mixed with the air was capable of supporting a column of mercury higher by .17 of an inch in Egypt than in England. The mean weight of water in a cubic foot of air in England was 3 grains, in Egypt 4.3; but still, owing to the higher temperature, the air was much drier in Egypt. At Greenwich the mean additional weight of water required to saturate a cubic foot of air was only .4 of a grain, while on the Nile it was 1.3 grains. If we represent air completely deprived of moisture by zero, and air completely saturated by unity, the mean degree of humidity on the Nile was 75 per cent., while at Greenwich it was 85 per cent. The mean readings of the barometer in Egypt were 29.99, at Greenwich 29.87, but the extreme range of the instrument was very small on the Nile. The average weight of a cubic foot of air at Greenwich was 549 grains, in Egypt 527. Rain fell in various districts of England on averages from 31 to 61 days, in Egypt only 5 days, and on three of these a shower lasted but few minutes. The mean daily range of the temperature of the air at Greenwich was $11^{\circ}.37$, in Egypt $10^{\circ}.31$, but while the mean extreme range in Egypt was 38° , at Greenwich it was but 29° . Fog was very rarely observed. — *London Athenæum*, Aug.

OBSERVATIONS IN LAPLAND AND THIBET.

In a memoir presented to the French Academy, on June 3, M. Bravais gives the results of some observations made in Lapland, according to directions received from the Academy, upon the change which takes place in the temperature of the air at various heights. The determinations were made by means of balloons and thermometers. At Bossekop, upon the western coast of Lapland, during the winter, the law of the variation of the temperature of the air in the first 100 or 200 metres above the earth depends chiefly upon the wind prevailing in the lower strata. With a sea-breeze, that is, between the southwest and the north-northwest, which blows about five days in a month, the decrease is a little more rapid than the mean decrease in our own climate, being about one degree for 90 or 100 metres. With a land-breeze, that is, from the south to the east-southeast, the temperature of the air at the earth falls, but increases upwards for about 100 metres, after which it decreases somewhat more rapidly than it increased.

Hourly meteorological observations made at Thibet, at an elevation of 18,400 feet, by Lieut. Strachey, show that the curves followed very nearly the same changes as they were observed to do in the lower regions. — *London Athenæum*, August.

GEOGRAPHY AND ANTIQUITIES.

NEW NAMES FOR THE AMERICAN CONTINENT.

IN a communication on "Linguistic Ethnology," by Prof. Halde-
man, published in the Proceedings of the American Academy, the fol-
lowing new names are proposed, as designations for scientific pur-
poses of various parts of the American continent. For America north
of 50°, *Hudsonia*; from this line to the tropics, *Hesperia* (or *Vesperia*);
the tropical portion, *Favonia*; from the southern tropics to 50° south,
Zephyria; and south of this, *Magellania*.

THE GREAT SALT LAKE.

IN 1849, Capt. Stansbury, of the Topographical Engineers, was ap-
pointed to make an examination of the valley of the Great Salt Lake,
and a hydrographic survey of that singular sheet of water. He has
transmitted some interesting despatches, from which extracts are made
by the *National Intelligencer*. His chief object was to make an explo-
ration of the west side of the lake, which has never before been done.
Col. Fremont, and all other explorers, have traversed the eastern
shore. The west was literally a *terra incognita*, — and, so far as dis-
coveries had extended, was known to be the most uninviting desert in
America. Capt. Stansbury writes: —

"We found that the whole western shore of the lake consists of im-
mense level plains of soft mud, inaccessible within many miles of the
water's edge to the feet of mules or horses, being traversed frequently
by meandering rills of salt and sulphur water, which apparently sink
and seem to imbue and saturate the whole soil, rendering it miry and
treacherous. These plains are but little elevated above the present
level of the lake, and have, without doubt, at one time, not very long
since, formed a part of it; for it is evident that a rise of but a few in-
ches will at once cover the greater portion of these extensive areas of
land with water again. I do not think I hazard much by saying, that a
rise of one foot in the lake would nearly, if not quite, double its present
area. The plains are, for the most part, entirely denuded of vegeta-

tion, excepting occasional patches of artemesia and 'grease-wood' and they glitter in the sunlight, presenting the appearance of water so perfectly, that it is almost impossible for one to convince himself that he is not on the immediate shore of the lake itself. This is owing to the crystallization of minute portions of salt on the surface of the mud, and the oozy slime occasioned by the complete saturation of the soil with moisture. From this cause, also, arises a *mirage* which is greater here than I ever witnessed elsewhere, distorting objects in the most grotesque manner, and giving rise to optical illusions almost beyond belief. I anticipate serious trouble from this cause, in making the triangulation.

"The first part of this desert was about seventy-five miles in extent, and occupied us two days and a half to cross it, travelling all day, and the greater part of the night; walking a great portion of the way to relieve the mules, which began to sink under the want of sustenance and water. In the latter portion of the first desert we crossed a field of solid salt, which lay incrustated upon the level mud plain, so thick that it bore up the mules loaded with their packs, so perfectly that they walked upon it as if it had been a sheet of solid ice, slightly covered with snow. The whole plain was as level as a floor. We estimated this field to be at the least ten miles in length, by seven in width, and the thickness of the salt at from one half to three quarters of an inch. A strip of some three miles in width had been previously crossed, but it was not thick or hard enough to prevent the animals from sinking through it into the mud at every step. The salt in the solid field was perfectly crystallized, and, where it had not become mixed with the soil, was as white and fine as the best specimens of Salina table salt. Some of it was collected and preserved. After crossing the field of salt we struck upon a fine little stream of running water, with plenty of grass, lying at the foot of a range of mountains, which seemed to form the western boundary of the immediate valley of the lake. The latter part of the desert was about seventy miles in extent, and was passed in two days, by prolonging our marches far into the night.

"From the knowledge gained by this expedition, I am of the opinion that the size of the lake has been much exaggerated; and from observation, I am induced to believe that its depth has been much overrated. That it has no outlet, is now demonstrated beyond doubt; and I am convinced, from what I have seen, that it can never be of the slightest use for the purpose of navigation. The water, for miles out from the shore, wherever I have seen it, is but a few inches in depth; and if there is any deep water, it must be in the middle. The Utah River (or the Jordan, as the Mormons call it), is altogether too insignificant and too crooked to be of any use commercially. The greatest depth of the Utah Lake that we have found is 16 feet; so that, for the purpose of a connected line of navigation, neither the river nor the lakes can be of the slightest utility. Such, at least, is my present impression. Further examination of Salt Lake may, perhaps, modify this opinion with regard to the latter. The river connecting these two lakes is forty-eight miles in length."

Capt. Stansbury has since returned home, and a detailed report of his operations will probably be soon published.

GEOGRAPHICAL EXPLORATIONS ON THE PACIFIC.

AN exploring commission, made up of officers of the Army and Navy, has examined the whole coast of California, north of San Francisco, and of Oregon as far as the parallel of 49° . Among other things, coal was found to exist in immense quantities all around Beaver Harbour, on the northeast part of Vancouver's Island, and on the main land obliquely opposite and still to the northward. Its quality for steaming purposes was found to be excellent.

In the course of these examinations, a party was despatched to visit carefully a large and well-sheltered harbour, known as Shoalwater Bay, and having its entrance some thirty miles north of Cape Disappointment. The prosecution of this service confirmed the fact, that the waters of the harbour and those of the mouth of the Columbia approach each other within a very short distance. The average length of the Bay is some twenty miles, and its breadth some six or eight. The bar at its entrance is understood to present no serious obstacle to the admission of ships of the largest class, at all seasons of the year. But one of the most remarkable features of this place is, that a ship may probably approach Baker's Bay, or Cape Disappointment, via its entrance, within some six or eight miles. — *California Courier*.

PROGRESS OF NAVIGATION.

AT the meeting of the American Association at Charleston, Lieut. Maury, in some remarks on the influence of the Gulf Stream upon navigation,* said that he had in his possession the log-book of a West India trader in 1746, which showed that her average rate of sailing per log was about one mile the hour. The instruments of navigation then were rude; chronometers were unknown, and lunars were impracticable; it was no uncommon thing for vessels in those days, when crossing the Atlantic, to be out of their reckoning 5° , 6° , and even 10° , and when it was announced that a vessel might know, by consulting the water thermometer, when she crossed the eastern edge of the Gulf Stream, and again when she crossed the western edge, navigators likened the discovery to the drawing of blue and red streaks in the water, by which they might when crossed be able to know their longitude.

The merchants of Providence, R. I., when Dr. Franklin was in London, sent a petition to the Lords of the Treasury, asking that the Falmouth (England) packets might run to Providence instead of to Boston; for they maintained that, though Boston and Falmouth were between Providence and London, yet that practically they were much further apart; for they showed that the average passage of the London traders to Providence was fourteen days less than that of the

* See *Annual of Scientific Discovery*, 1850, p. 160.

packet line from Falmouth to Boston. Dr. Franklin, on being questioned as to this fact, consulted an old New England captain, who had been a whaler, and who informed the Doctor that the London traders to Providence were commanded for the most part by New England fishermen, who knew how to avoid the Gulf Stream, while the Falmouth packets were commanded by Englishmen, who knew nothing about it. These two drew a chart, which was published at the Tower, and the Gulf Stream, as laid down there by that Yankee whaler, has been preserved upon our charts until within a few years. The influence of the Gulf Stream thus becoming known through the influence of Dr. Franklin and the discovery of the water-thermometer, the course of trade formerly setting toward Charleston, S. C., was diverted to the Northern ports. This revolution commenced about 1795. It worked slowly at first, but in 1816-17 it received a fresh impulse from Jeremiah Thompson, Isaac Wright, and others, who conceived the idea of establishing a line of packets between New York and Liverpool. This was a period when the scales of commercial ascendancy were vibrating between New York, Boston, Philadelphia, and other places. The packet-ships of Thompson turned the balance. Though only of 300 tons burden, and sailing but once a month, they had their regular day of departure, and the merchants of Philadelphia, Charleston, etc., found it convenient to avail themselves of this regular and stated channel, for communicating with their agents in England, ordering goods, etc., and from that time the commerce of New York has gone on steadily increasing.

NEW ROUTE FOR VESSELS TO THE EQUATOR.

In a letter to the Secretary of the Navy, dated May 13, Lieut. Maury says: — "The investigations with regard to the winds and currents of the ocean have led me to the discovery of a new route hence to the equator, by which the passage of all vessels trading under canvas, whether to South America, China, India, or Australia, to California, Polynesia, or the markets of the Pacific, has been shortened several days." In order to show the importance of this discovery, he submits a tabular statement exhibiting the passages of 88 vessels by the new, and of 73 by the old route, which were taken at random, and are believed to afford a fair average. The average passage by the old route to the equator is forty-one days. The passage by the new route has frequently been made in half that time, and even in less. "The vessels which have taken the new route in February and March have had, on the average, a passage of fourteen or fifteen days less than those which have taken the old route at the same season. It will be observed by this statement, that the average passage to the equator during the half-year which comprises the winter and spring months has been shortened ten days by the new route, and by more than a week, on the average, the year round."

THE LAKE NGAMI IN SOUTH AFRICA.

Jameson's Journal, for July, contains a communication on "the discovery of the great Lake Ngami of South Africa," in which is incorporated a letter from the discoverer, Rev. David Livingston, who, with his friends Messrs. Murray and Oswell, started on June 1, 1849, from Kolobeng (25° S. lat., and 26° E. long.), to penetrate the desert in search of the lake. After a march of about 300 miles, the party struck on a magnificent river on the 4th of July; and, following along the banks of this nearly 300 miles more, reached the Batarama, on the Lake Ngami, in the beginning of August. The Bakoba, the inhabitants of this region, are a totally distinct race from the Bechuanas, and are much darker than they. "We greatly admired," says Mr. Livingston, "the frank, manly bearing of these inland sailors; who paddle along their river and lake in canoes hollowed out of the trunks of immense trees, take fish in nets made of a weed abounding on the banks, and kill hippopotami with harpoons attached to ropes." The higher the party ascended the river, the broader it became, until it measured upwards of 100 yards in breadth between the wide belt of reeds lining the sides. The water was clear as crystal, soft, and cold. The Zonga is reported to communicate, not only with the lake, but also with other large rivers coming from the north. One remarkable feature of the river is its periodical rise and fall. During the short time the party remained, it rose nearly three feet in height, and this too in the dry season. This rise is evidently not caused by rain, the water being so pure; and besides, the purity increased as the party ascended towards its junction with Tamunakle, from which river it receives a large supply. "The sharpness of the air caused an amazing keenness of appetite, at an elevation of little more than 2,000 feet above the level of the sea (water boiled at $207\frac{1}{2}^{\circ}$), and the reports of the Bakoba, that the water came from a mountainous region, suggested the conclusion that the increase of the water, at the beginning and middle of the dry season, must be derived from melting snow." With the periodical rise of the rivers large shoals of fish descend. The latitude of the east corner of the lake at its junction with the effluence of the Zonga is, by sextant, $20^{\circ} 20'$ S. The longitude was estimated at 24° E.; consequently about midway between the eastern and western coasts. The height above the level of the sea was found by thermometer to be 2,200 feet. The length and breadth were stated by the natives at 70 and 15 miles, and the travellers saw in the former direction an uninterrupted horizon of water. It is stated to bend towards the northwest at its farther end, where it receives another river similar to the Zonga. The latter, it must be remembered, runs to the northeast, and probably does not communicate with the ocean, but its waters are dissipated by evaporation and absorption. The banjan, the palmyra, and the baobab are found on its borders, and indicate a better watered country than any previously reached from the Cape. The head of a fish which abounds in the lake, as well as a fearful fly, which stings the oxen to death, have been sent home, and declared to be new.

THE SOURCES OF THE NILE.

At the meeting of the Franklin Institute, on Sept. 19, Mr. G. W. Smith called attention to a printed copy of a letter from Mr. James McQueen, dated London, Aug. 26, stating that the sources of the Nile had at last been ascertained, in its main or eastern branch, by recent journeys from the north and from the southeast coast of Africa; Portuguese travellers having recently made us acquainted with the sources of the western branch. The expedition of the Pacha of Egypt, in January, 1840, traced it at the time to latitude $3^{\circ} 22' N.$, and longitude $31^{\circ} 41' E.$, there 1,300 feet broad, and coming from the southeast from a lake. From that point to the source is a distance, in the general bearing, of 270 geographical miles, sufficiently great to form a river of that magnitude, especially in a country so mountainous as that portion of Africa is found to be. The Rev. Dr. Kraff, a missionary long stationed in Eastern Africa, has at length obtained this important information. In a journey he reached, in latitude $1^{\circ} S.$ and longitude $35^{\circ} 30' E.$, Kitu, the capital of the Unbekani, a fine and friendly people. There he saw to the northwest, distant about six days' journey, Mount Kenia rising far above the limits of perpetual snow, from the southern base and side of which springs the river Dani; and to the north of it, he was told, rose a river running north, down which the people went, to the country of the white people, doubtless the Nile. The Nile is, therefore, not only the longest river on the earth, but runs through more degrees of latitude than any other known.

THE RUIN AT NEWPORT, R. I.

At the meeting of the New York Historical Society, on Nov. 5, Rev. Dr. Robinson referred to the celebrated ruin at Newport, R. I., known as the "Old Windmill," which the scholars of Denmark, as well as some in our own country, have considered the work of the Northmen, who are supposed to have visited the spot long before the discovery of America by Columbus. Dr. R. read an extract from the will of Gov. Benedict Arnold, which was executed in 1676, in which, speaking of the spot where he desired to be buried, he describes it as "on the line or path leading from my house to my stone-built windmill." The windmill spoken of here, Dr. Robinson maintained to be the one whose ruins remain, inasmuch as no other windmill of stone now exists, or is known to have existed, while its locality agrees with the description, as the place of Gov. Arnold's burial is still known. — *N. Y. Literary World*, Nov. 30.

It is proper to add, that many objections have been raised against the view of Dr. Robinson. — *Editors*.

MEXICAN ANTIQUITIES.

At the meeting of the London Archæological Institute, on April 5, Mr. Empson exhibited a collection of gold ornaments, idols, and other relics found in Mexico, in the Lake of Guatavita, which had been re-

garded as sacred previous to the conquest by the Spaniards. The aborigines were accustomed to throw into it treasures as offerings to their deities, and immense wealth is supposed to be deposited beneath its waters. — *London Athenæum*, April.

ANCIENT MONUMENTS ON THE ISLANDS OF LAKE NICARAGUA.

At the meeting of the Ethnological Society of New York, on March 2, a long paper from Hon. E. G. Squier was read, describing some discoveries he had made on the islands of Lake Nicaragua, in Central America. On the island of Pensacola, he discovered two large blocks of stone, which proved to be large and well-proportioned statues of superior workmanship. The smaller of the two had evidently been purposely buried, and its arm was broken. "It represented a human male figure, of massive proportions, seated upon a square pedestal, its head slightly bent forward, and its hands resting on its thighs. Above the head rose a heavy and monstrous representation of the head of an animal, below which could be traced the folds of a serpent, the fierce head of which was sculptured, open-mouthed, and with life-like accuracy, by the side of the face of the figure. The whole combination was elaborate and striking; but the fact of most interest, in an archæological point of view, is, that the surmounting animal head is the sacred sign of *Tochtli* of the Mexican calendar, corresponding very nearly, if not exactly, with the bas-relief of that sign on the great calendar stone of Mexico, and with the painted representations in the Mexican MSS. The stone from which the figure here described is cut, is a hard basalt; but the sculpture is bold, and the limbs, unlike those of the monoliths of Copan, are so far detached as could be done with safety, and are cut with a freedom which I have observed in no other statuary works of the American aborigines."

The larger and by far the most interesting of the two statues was after much trouble uncovered and raised. "It represented a man with massive limbs, and broad, prominent chest, in a stooping, or rather crouching, posture, his hands resting on the thighs just above the knees. Above his head rose the monstrous head and jaws of some animal; its fore paws were placed one upon each shoulder, and the hind ones upon the hands of the statue, as if binding them to the thigh. It probably was intended to represent an alligator, or a similar mythological animal. Its back was covered with carved plates, like rough mail. The whole rose from a broad, square pedestal. Its carving was bold and free. I never have seen a statue which conveyed so forcibly the idea of power and strength." A portion of a third statue was afterwards accidentally discovered upon the same island. "The lower half had been broken off, and could not be found; what remained was simply the bust and head. The latter was disproportionately great; the eyes were large, round, and staring; the ears broad and long; and from the widely-distended mouth, the lower jaw of which was forced down by the two hands of the figure, projected a tongue which reached to the breast, giving to the whole an unnatural and horrible expression."

A visit to the island of Zapatera in the same lake brought to light some fifteen of these idols in a perfect condition, besides some fragments. Several stones of sacrifice were also found. Mr. Squier says of these last discovered statues, — "They are very different from those discovered by Mr. Stephens at Copan. There is no attempt at drapery in any of the figures. Some are erect, others seated, and still others are in crouching or reclining postures. The material, in every case, is a black basalt. A few of the figures, from defects of the stone, have suffered somewhat from the weather, but less from this cause than from the fanaticism of the conquerors." By excavating, much broken pottery was discovered, many of the fragments of which are painted in bright colors. Two of the smaller statues were removed to be forwarded to New York. One of them represents a tiger springing with open mouth upon the head and back of a sitting figure. — *New York Literary World*.

NEW DISCOVERIES AT NINEVEH.

LETTERS containing notices of Mr. Layard's new discoveries at Nineveh and its vicinity have appeared from time to time in various English journals, and from them we have compiled the following account, which does not pretend to be chronologically arranged.

A Mr. Rolland, writing from Nineveh, where he is assisting Layard, says, — "The first two or three days at Mossul I spent in examining the first excavations at Koyunjik, where fresh slabs are being every day brought to light. Two new colossal bulls and two colossal figures were discovered while I was there, at the entrance of the city gates; and the pavement at the gateway, marked with ruts by chariot-wheels, was also uncovered." At Nineveh, he afterwards writes, "I am sinking wells in all directions, and am not without hopes of discovering subterranean chambers, which I am convinced must exist. In one place, considerably below the level of any of the hitherto discovered monuments, a brick arch between two walls of brick has been uncovered; it is a puzzle to us all. Another great discovery is an immense stone wall of most solid masonry inside the brick pyramid. The workmen are laboring to force an entrance into it, but their progress is necessarily very slow, not exceeding a foot or two in a day." During the temporary absence of Mr. Layard and the writer, the workmen had opened a trench, by Layard's direction, "to show my wife a certain slab which he had buried; in doing so, they uncovered three copper caldrons of immense size, and some huge dishes of metal. Layard carefully removed the earth from one caldron which was partially filled with it, and discovered an immense variety of ivory ornaments, an iron axe-head, and innumerable other articles, which for the present I must forbear to mention, having promised secrecy. Layard removed as many as he could, and covered the rest with earth. It is by far the most important discovery that has yet been made."

At a later period extensive excavations were made in parts of the mound of Nimroud not before explored, and the result was the discovery of the throne upon which the monarch, reigning about 3,000 years

ago, sat. It is composed of metal and of ivory, the metal being richly wrought and the ivory beautifully carved. It seems that the throne was separated from the state apartments by means of a large curtain, the rings by which it was drawn and undrawn having been preserved. No human remains have come to light, and every thing indicates the destruction of the palace by fire. It is said that the throne has been partially fused by the heat. Under the date of Jan. 6, a writer says, —“Yesterday we removed more than thirty metal vases, bowls, and saucers, most beautifully embossed and engraved, some shields and swords, of which the handles alone remain, the iron blades being decomposed, and a small marble vase. The cups and bowls and other ornaments are of some unknown alloy of metals, but they are all so incrustated with decomposed and crystallized copper, and so fragile, that they cannot be handled without great danger, and Mr. Layard is sending them home in the state in which he found them, without attempting to remove the rust. Not the least curious part of the discovery are several hundred mother-of-pearl studs, in form exactly resembling our shirt buttons.” In a part of the building not far distant from that containing the throne, the whole of the culinary apparatus of the monarch of Assyria has been discovered. It consists, among other things, of an immense brazen caldron, and more than 100 dishes, &c., of the same metal. No golden utensils have, however, yet come to light.

The *Literary Gazette* states that, at Koyunjik, Mr. Layard has found a chamber which is completely filled with terra-cotta tablets, the inscriptions on which are stamped in, so that, though Major Rawlinson thinks it very probable these tablets may be records of the empire, it is still not unlikely that many of them may, in fact, be duplicates of, or a collection of, manifestoes for issuing to the people or their immediate rulers; in short, a sort of Assyrian official printing-office. We believe that no fewer than twenty-five cases are on their way to England. In the pyramid at Nimroud, also, a unique statue has been discovered. It is from four to five feet in height, in gypsum, elaborately carved and very perfect. There is also a high relief of the king, very beautifully executed, standing in an arch eight feet high, and covered with minute inscriptions.

A vessel has reached London with some of the results of these late excavations. The two most remarkable specimens are the gigantic bull, already known by report, and a lion of nearly equal dimensions. Both these animals are constructed on precisely the same principle. The heads are human, with caps upon them, and beards elaborately curled, and they have the large spreading wings so frequent in Assyrian antiquities. The side view of them is in bas-relief, and so seen they appear to be in motion, the off-legs being inclined backwards. The head, however, and one of the front legs, are brought to the edge of the slab, round which they are carried so as to present a full front view; a fifth leg is added, in a stationary position, to correspond with the others. These figures are in size from nine to ten feet square. Another curious specimen is a group of two human figures, in very high relief, each dressed in a cap ornamented with horns. This is at present in separate pieces, having been apparently sawn for facility of conveyance.

PATENTS.

TABLE SHOWING THE NUMBER OF PATENTS ISSUED DURING EACH MONTH OF THE YEAR 1850.

[The two following tables have been compiled from the *Journal of the Franklin Institute* and the *Scientific American*. The classes into which the first one is divided are those of the Patent-Office, but our assignment of particular patents probably differs much from theirs. Each class includes all those in any way related to it. Thus, under "Lumber" are placed all machines for its manufacture.]

Classes.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Agriculture,	10	5	9	11	6	5	14	3	13	20	4	7	107
Metallurgy,	2	3	3	5	5	5	4	3	5	6	9	5	55
Fibrous and Textile Substances,	2	6	5	3	6	4	6	5	7	5	3	4	62
Chemical Processes,	9	2	6	4	3	1	5	3	7	3	5	2	50
Light and Heat,	6	4	11	10	9	5	3	3	2	2	4	3	67
Steam and Gas Engines,	5	1	3	4	5	5	5	1	2	2	5	3	38
Navigation,	1	1	4	2	3	2	3	5	1	1	2	2	26
Philosophical Instruments,	2	1	4	1	2	4	1	1	1	1	1	1	19
Civil Engineering,				1	2	2			1	1			7
Land Conveyance,	2	6	11	6	1	8	4	5	2	6	2	4	57
Hydraulics and Pneumatics,	1	2	2	3	1	1	1	1	1	1	1	2	14
Pressing, Weighing, &c.,	2	3	9	6	1	2	2	3	2	4	3	3	37
Grinding-mills,	6	1	2	3	2				1	2	4	4	21
Lumber,	9	5	3	3	8	2	5	6	4	3	6	5	59
Stone and Clay,	2	1	5	1	3	1			1				14
Leather,	1	2	2	5	3	3	1	2		1		2	22
Household Furniture,	9	11	2	6	4	4	5	3	3	4	3	2	56
Printing, the Arts, &c.,	4	3	4	6	2	2	1	4	6	4	1	5	42
Fire-arms,			3	2	1	2	2	3	4		1		13
Surgery,	4		4	2	1	1	2	5	1			2	22
Wearing Apparel,	1	1	1	1	4			1	2	1	1		13
Miscellaneous,	2	9	11	17	4	5	5	2	2	8	5	6	76
Total Patents,	83	67	97	106	73	61	73	67	67	74	50	64	832
Re-issues,	3	4	1	1	4	1		3	4	3	2	1	27
Designs,	1	11	7	5	5	10	8	8	12	6	6	2	81
Additional Improvements,	1			1				2					4
Total,	88	92	105	113	82	72	81	78	85	83	58	67	994

TABLE SHOWING THE NUMBER OF PATENTS ISSUED TO CITIZENS OF THE DIFFERENT STATES.

Maine,	10	Massachusetts,	143	New York,	302
New Hampshire,	18	Rhode Island,	13	New Jersey,	24
Vermont,	13	Connecticut,	56	Pennsylvania,	153

Delaware,	3	Arkansas,	1	Texas,	2
Maryland,	22	Tennessee,	7	Iowa,	0
Virginia,	20	Kentucky,	8	Wisconsin,	3
North Carolina,	3	Ohio,	90	District of Columbia,	12
South Carolina,	4	Michigan,	3	Foreign,	25
Georgia,	6	Indiana,	22	Not stated,	1
Alabama,	2	Illinois,	15		
Mississippi,	2	Missouri,	7	Total,	994
Louisiana,	7	Florida,	0		

Patents, re-issues, designs, and additional improvements are all included in the above table.

OBITUARY

OF PERSONS EMINENT IN SCIENCE. 1850.

Thomas Amyot, F. R. S.

Lieutenant Bache, U. S. N., drowned in California.

William Beer, a celebrated astronomer, who, in conjunction with Maedler, published the "Mappa Selenographica," or Map of the Moon, which gained for the authors the Lalande prize from the French Academy. He also published a work called "General Compared Selenography."

M. Edouart Biot.

M. Ducrotay de Blainville, the successor of Cuvier in the chair of Comparative Anatomy at the Museum of Natural History, in Paris; a very distinguished naturalist, and the author of several elaborate works.

Sir Felix Booth, who subscribed nearly £20,000 to defray the expenses of Sir John Ross's expedition to the North Pole, and made a weekly allowance to the wives of the sailors during their absence. Boothia Felix was named in his honor.

John Burns, Professor of Surgery in the University of Glasgow. He was the author of several well-known medical works.

John Caldecott, astronomer to the Rajah of Travancore, died at Trevandrum, India, December, 1849.

Prof. Canstatt of the University of Erlangen, a distinguished physician.

Prof. Stephen Chase, Professor of Mathematics in Dartmouth College.

William R. Clanny, a well-known surgeon, and a writer on mining matters. He devised in 1813 a safety-lamp for mines, and received medals from the London Society of Arts and the Humane Society. Although his lamp was successful, it was very cumbersome, and was superseded by Davy's in 1816.

Dr. N. Royer Collard, Professor of Hygiene at Paris.

John Dennett, the inventor of the shipwreck rocket known by his name.

Joseph Droz, member of the French Academy.

Lieut. Henry Eld, U. S. N. He was the first to descry the Antarctic Continent, discovered by the United States Exploring Expedition, Jan. 16, 1839.

M. de Felitz, Member of the French Academy.

Dr. Fouquier, Professor of *Clinique Interne* at the Paris Academy of Medicine.

M. Benjamin Francœur.

Lieut. Gale, the aeronaut, killed in making his one hundred and tenth ascent.

Dr. William Gambel, an eminent naturalist, formerly Secretary of the Academy of Natural Science, Philadelphia. He died while making an exploration in California.

Gay-Lussac, one of the most distinguished scientific men of the age. There is no branch of the physical and chemical sciences which is not indebted to him for some important discovery. He discovered, among other things, the fundamental laws of the expansion of gas and vapors, made a balloon ascent which was productive of many interesting results, and wrote many works upon chemistry. He was equally distinguished as a natural philosopher and a chemist.

Dr. R. E. Griffith, Professor of *Materia Medica, &c.*, in the University of Virginia. He was the author of a Medical Botany and a Universal Formulary.

Joseph Hardy, inventor of a machine for doubling and twisting cotton-yarn, for which he received a reward from the Dublin Society; also of a scribbling machine for carding

wool, for which he received from the same Society 100 guineas, and of various other machines.

C. Hullmandel, celebrated for his improvements in lithography, for which he received a gold medal from the King of the French.

— *Johnson*, patentee of an anti-combustible rope.

Rev. William Kirby, the father of English entomology, and the author of many works upon this subject, the best known of which is the "Introduction to Entomology," written in connection with Mr. Spence. He was Honorary President of the Entomological Society of London, and Fellow of the Royal, Linnæan, Geological, and Zoölogical Societies of the same city.

Prof. Kolderup, of the University of Copenhagen.

Charles Kunth, Professor in the University of Berlin. In descriptive botany he gained great reputation. It was he who arranged and described the American plants collected by Humboldt and Bonpland.

Darius Lapham.

John Lowry, formerly Professor of Mathematics in the Royal College of Lindhurst.

M. Marjolin, a distinguished physician of Paris, and Professor in the Faculty of Medicine in that city.

Oliver H. Matthews, an eminent mining engineer, member of the Royal Geological Society, England, and of the Boston Natural History Society.

Dr. M'Fadyen, an English botanist of distinction; author of the "Flora of Jamaica."

Doctor Medicus, Professor of Botany at Munich, and member of the Academy of Sciences of that city.

Sir Robert Peel, the most distinguished patron of science who has held the office of Prime Minister of Great Britain.

Dr. Potts, inventor of the hydraulic pile-driving process, and other mechanical improvements.

Dr. William Prout, F. R. S., author of the Bridgewater Treatise on Chemistry, Meteorology, and the Function of Digestion considered with Reference to Natural Theology. He was also the author of various other works.

Dr. Prus, distinguished for the part he took in the discussion on the Oriental plague, some years since, in the Paris Academy of Medicine.

M. Raffeneau de Lile, botanist.

Adam Ramage, well known as the inventor of the "Ramage printing-press."

Capt. George Smith, R. N., the inventor of a superior sight for ship's guns, of a lever or movable target, and of paddle-box safety-boats for steamships.

James Smith, an eminent agricultural writer, to whom English agriculture is much indebted.

M. P. Souyet, Professor of Chemistry at the Musée de l'Industrie and Royal Veterinary School at Brussels. He was the author of several works, and made some important discoveries.

Capt. Owen Stanley, R. N., member of the Geographical Society of London.

Robert Stevenson, of Scotland, the designer and builder of the Bell Rock Light-house. He also executed many engineering works in Scotland.

Capt. George W. Taylor, the inventor of the submarine armour known by his name.

Rev. George Thackeray, a well-known English naturalist.

J. C. Treffry, well known in mining circles in Great Britain.

Dr. Gerard Troost, Professor in the University of Nashville, and Geologist of the State of Tennessee. His geological reports are very elaborate and valuable, and his researches upon the fossil crinoids of Tennessee are well known.

Dr. Amos Twitchell, a distinguished physician and surgeon of Keene, N. H.

William Vaughan, F. R. S.

Dr. John W. Webster, for twenty-four years Professor of Chemistry in Harvard College.

Rev. David Williams, well known as a geologist.

J. H. Wilson, Fellow of the Linnæan Society of London, and translator of Jussieu's Elements of Botany.

LIST OF BOOKS, PAMPHLETS, &c.,

ON MATTERS PERTAINING TO SCIENCE, PUBLISHED IN THE UNITED STATES DURING THE YEAR 1850.

-
- Acalephæ of North America. Agassiz.
 Account of a Compound Microscope, manufactured by C. A. Spencer, by Gilman. New Haven.
 Algæ and Corallines of the Bay and Harbour of New York, by Durant. Putnam. New York.
 American Almanac for 1851. Little & Brown. Boston.
 Ancient Monuments of the State of New York, by Squier. Smithsonian Contributions.
 Annals of the Lyceum of Natural History. New York.
 Annual of Scientific Discovery for 1850, by Wells and Bliss. Gould, Kendall, & Lincoln. Boston.
 Artist's Chromatic Handbook, by Ridner. Putnam. New York.
 Botanical Text-Book, by Gray. Putnam. New York.
 Botany, by Newman. Fowler & Wells. New York.
 Bridges, Viaducts, Tunnels, &c., of the Railroads of the United States, by Duggan. New York.
 Builder's Companion, by Smeaton. Baird. Philadelphia.
 Cabinet-Maker and Upholsterer's Companion, by Stokes. Baird. Philadelphia.
 Catalogue of Shells in the Collection of Mr. Jay, of New York.
 Catechism of the Steam-Engine, by Bourne. Appleton. New York.
 Chart of Chemistry, by Yomans. Yomans & Burdsall. New York.
 Chemical Experiments, by Francis. Daniels & Smith. Philadelphia.
 Chemical Tables for the Calculation of Quantitative Analyses, by Rose. Translated by Dexter. Little & Brown. Boston.
 Chloride of Zinc, its Economic and Sanitary Relations, by Hayes. Boston.
 Classification of Insects from Embryological Data, by Agassiz. Smithsonian Contributions.
 Contributions to Conchology, by Adams. Amherst.
 Contributions to the Physical Geography of the United States, by Ellet. Smithsonian Contributions.
 Cosmos, by Humboldt. Translated by Otte. Harpers. New York.
 Curiosities of Animal Life as developed by the Microscope. Lane & Scott. New York.
 Cyclopædia of Useful Arts. G. Virtue. New York.
 Daily Record of the Thermometer from 1840 to 1850, by Delatour. New York.
 Description of some American Annelidæ, by Leidy. Philadelphia.
 Dictionary of Mechanics, by Byrne. Appleton. New York.
 Dictionary of Scientific Terms, by Hoblyn. Appleton. New York.
 Dictionary of Terms used in Natural History, by Ruschenberger. Lippincott, Grambo, & Co. Philadelphia.
 Discovery of a Comet, by Miss Mitchell. Smithsonian Contributions.
 Diseases of the Interior Valley of North America, by Drake. Smith & Co. Philadelphia.
 Doctrine of the Unity of the Human Race examined on the Principles of Science, by Bachman. Charleston.
 Dyer and Color-Maker's Companion. Baird. Philadelphia.
 Earth and Man, by Guyot. New Edition. Gould & Lincoln. Boston.
 Echoes of the Universe, by Christmas. Hart. Philadelphia.
 Elementary Chemistry, by Fownes. Edited by Bridges. Lea & Blanchard. Philadelphia.

- Elements of Calculus, by Church. Putnam. New York.
 Elements of Chemistry, Graham. Second Edition. Baillière. New York.
 Elements of Military Art and Science, by Hallock. Appleton. New York.
 Elements of Natural History, by Ruschenberger. Lippincott, Grambo, & Co. Philadelphia.
 Elements of Natural Philosophy, by Gray. Harpers. New York.
 Elements of Natural Philosophy, by Bartlett. A. S. Barnes & Co. New York.
 Elements of Scientific Agriculture, by Norton. E. H. Pease & Co. Albany.
 Elements of Trigonometry, by Hackley. Putnam. New York.
 Encyclopædia of Chemistry, Practical and Theoretical, by Booth. Baird. Philadelphia.
 Engineers and Mechanics' Pocket Book, by Haswell. Harpers. New York.
 Exploring Expedition to the Rocky Mountains, California, and Oregon, by Fremont. Derby & Co. Buffalo.
 Farmer's Guide to Scientific and Practical Agriculture, by Stephens. Edited by Norton. Leonard Scott & Co. New York.
 Field Artillery, Horse and Foot. Cushing & Bro. Baltimore.
 Footprints of the Creator, by Miller. Gould & Lincoln. Boston.
 Formula for Construction of Railroads, Borden. Little & Brown. Boston.
 Geography of Palestine, by Schwartz. Translated by Leser. Hart. Philadelphia.
 Geological Chart, by Foster. Albany.
 Geological Report of the Lake Superior Copper Region, by C. T. Jackson. Pub. Doc.
 Geology and Mineral Resources of California, by Tyson. Pub. Doc. Minifie & Co. Baltimore.
 Gothic Architecture applied to Modern Residences, by Arnot.
 Guide to the Scientific Knowledge of Things Familiar, by Brewer. Francis & Co. New York.
 Half-yearly Abstract of the Medical Sciences, by Rankin. Lindsay & Blakiston. Philadelphia.
 History of Propellers and Steam Navigation, by Macfarlane. Putnam. New York.
 Iconographic Encyclopædia, by Baird. Garrigue. New York.
 Illustrations of Natural Philosophy, by Mayo. Putnam. New York.
 Illustrations of the Fossil Footprints of the Valley of the Connecticut, by Doane.
 Introduction to Practical Chemistry, by Bowman. Lea & Blanchard. Philadelphia.
 Investigation of the Reciprocal Action of Galvanic Currents on each other, by Secchi. Smithsonian Contributions.
 Kedge Anchor, or Young Sailor's Assistant. Brady. New York.
 Lake Superior, its Physical Character, Vegetation, and Animals, by Agassiz. Gould, Kendall, & Lincoln. Boston.
 Lectures on the Relations of Science to Agriculture, by Johnston. Saxton. New York.
 Lectures on Practical Agriculture, by Johnston. Leonard Scott & Co. New York.
 Liebig's Works on Chemistry. Petersen. Philadelphia.
 Lives of Literary and Scientific Men of America, by Wynne. Appleton. New York.
 Logic and Utility of Mathematics, by Davis. A. S. Barnes & Co. New York.
 Manual of Auscultation and Percussion, by Barth and Rogers. Lindsay & Blakiston. Philadelphia.
 Map of the Operations of the U. S. Army in Texas and on the Rio Grande, with Astronomical Observations and Notes of the Country. Pub. Doc.
 Map of the Operations of the U. S. Army in the Valley of Mexico. Pub. Doc.
 Mathematics for Practical Men, by Gregory. Baird. Philadelphia.
 Mechanical Drawing-Book. Minifie & Co. Baltimore.
 Mechanics' Text-Book, by Kelt. Phillips, Sampson, & Co. Boston.
 Medical Application of Electro-Magnetism. Smith. New York.
 Medical Botany of South Carolina, by Porcher. Philadelphia.
 Medical Chemistry, by Gardner. Lea & Blanchard. Philadelphia.
 Medical Chemistry, by Bowman. Lea & Blanchard. Philadelphia.
 Medicine, a Science and an Art, by Coventry. Geneva, N. Y.
 Methods of Location, or Modes of Describing and Adjusting Railway Curves and Tangents, by Griffin. Daniels & Smith. Philadelphia.
 Method of Solving Cubic Equations, by Strong. Smithsonian Contributions.
 Monograph of Vitrinella, with New Species, by Adams. Amherst.
 Mosasaurus and Allied Genera, by Gibbes. Smithsonian Contributions.
 New Elements of Geometry, by Smith. Putnam. New York.
 North American Sylva, or Descriptions of the Forest Trees of the United States, Canada, and Nova Scotia, by Michaux, with Notes by Smith. Putnam. New York.
 North American Sylva, with those not described in Michaux's Work, by Nuttall. Putnam. New York.
 Notes from Nineveh, by Fletcher. Lea & Blanchard. Philadelphia.
 Observations on Planetary and Celestial Influences in the Production of Epidemics, by Bowron. Taylor. New York.

- Occultations for 1851. Smithsonian Contributions.
 On the Overflowed Lands of Louisiana. Pub. Doc.
 Painter, Gilder, and Varnisher's Companion. Baird. Philadelphia
 Physical Atlas of Natural Phenomena, by Johnston. Lea & Blanchard. Philadelphia.
 Plan for Shortening the Passage between New York and London.
 Poetry of Science, by Hunt. Gould, Kendall, & Lincoln. Boston.
 Popular Anatomy and Physiology, by Lambert. Leavitt & Co. New York.
 Principles of Chemistry, by Stockhardt. Translated by Peirce. John Bartlett. Cambridge.
 Pre-Adamite Earth, Harris. Gould, Kendall, & Lincoln. Boston.
 Proceedings of the American Association for the Advancement of Science, Cambridge Meeting. Munroe & Co. Boston.
 Proceedings of the American Association for the Advancement of Science. Charleston Meeting.
 Progress of Astronomy, by Loomis. Harpers. New York.
 Races of Men, by Knox. Lea & Blanchard. Philadelphia.
 Railway Economy, by Lardner. Harpers. New York.
 Relation between the Scriptures and Geological Science, by Smith R. E. Petersen. Philadelphia.
 Remarks on the Use of Alcohol in the Preparation of Medicine. Boston.
 Report of the Commissioner of Patents, by Ewbank. 1849, Part I. Pub. Doc.
 Report of the Committee on Medical Sciences, presented at the Third Annual Meeting of the American Medical Association.
 Report on California, by King. W. Gowan. New York.
 Report on the Geology of Alabama, by Tuomey.
 Report of a Geological Reconnoissance of the Chippewa Land District of Wisconsin, by Owen. Pub. Doc.
 Report on the History of the Discovery of Neptune, by Gould. Smithsonian Contributions.
 Report on the Progress of the Coast Survey for 1849, by Bache. Pub. Doc.
 Report and Map of the Route from Fort Smith to Santa Fé, by Simpson. Pub. Doc.
 Report on the State Cabinet of Natural History of New York.
 Report on Agriculture to Maryland Legislature. Higgins.
 Report of the Visiting Committee of the Lawrence Scientific School, Cambridge.
 Researches on Neptune. Sears C. Walker. Smithsonian Contributions.
 Sailing Directions, by Maury. Pub. Doc.
 Specimens of the Stone, Iron, and Wood Bridges of the United States, by Duggan. Appleton. New York.
 Spectacles, their Uses and Abuses, by Sichel. Edited by Williams. Phillips, Sampson, & Co. Boston.
 State of Agriculture in England, by Johnston.
 Surgical Anatomy, by MacLise. Lea & Blanchard. Philadelphia.
 Syllabus of a Course of Lectures on Chemistry, by Solly. Baird. Philadelphia.
 System of Aeronautics, by Wise. Speed. Philadelphia.
 System of Mineralogy, by Dana. Third Edition. Putnam. New York.
 Text-Book of Geometrical Drawing. Minifie & Co. Baltimore.
 Travels in Siberia, by Erman. Translated by Cooley. Lea & Blanchard. Philadelphia.
 Treatise on Astronomy and the Use of Globes, by McIntire. A. S. Barnes & Co. New York.
 Treatise on Hothouses. Jewett & Co. Boston.
 Treatise on Marine and Naval Architecture, by Griffith. Berford & Co. New York.
 Treatise on Physical Geography, by Barrington. Edited by Burdett. Mark Newman & Co. New York.
 Treatise on Plane and Spherical Trigonometry, by Chauvenet. Perkins. Philadelphia.
 Treatise on the Theory and Practice of Naval Gunnery, by Jeffers. Appleton. New York.
 United States Exploring Expedition under Wilkes, by Jenkins. Alden. Auburn, N. Y.
 Unity of the Human Races, by Smyth. Putnam. New York.
 Universal Dictionary of Weights and Measures, by Alexander. Minifie & Co. Baltimore.
 Uses and Abuses of Air, by Griscom. Redfield. New York.
 Views of the Microscopic World, by Brocklesby. Pratt, Woodford, & Co. New York.
 World as it Appears. Crocker & Brewster. Boston.

FRENCH WEIGHTS AND MEASURES

REDUCED TO ENGLISH STANDARDS.

As the system of French weights and measures is frequently referred to in this volume, and is now generally adopted for scientific purposes, we insert the following explanation of the system, with a table of measurements, reduced to English equivalents.

The French unity of length and weight is based on an invariable dimension of the globe, recognizable in all countries. It is independent of all extrinsic notions, such as gravity, and the arbitrary subdivisions of duration, an advantage which the length of a seconds pendulum does not present. The basis assumed is the fourth part of a meridian, or of an ideal circle going round the globe from pole to pole, at right angles with the equator. The length of this fourth of a meridian is divided into 10,000,000 parts; a single ten-millionth part is a metre, or the unity of long measure. A square measuring on each side 10 metres forms the *are*, or the unity of the mensuration of surface. (160 ares are nearly equal to one English acre.) A cube measuring on each of its sides one metre constitutes the *stere*, used for dry measure. A cube measuring on each of its sides the tenth part of a metre is the unity of volume. A vessel gauging such a cube is called the *litre*. (A litre equals about a quart, English measure.) The weight of a cube of water at 39° F., its point of maximum density, measuring on each of its sides the hundredth part of a metre, is the unity of weight, a gramme. A thousand grammes of pure water at the same temperature are of course equivalent to a litre.

These unities being often too great or too small for common use, they constitute the basis of new unities on the simple decimal principle. The names of these new unities are formed from Greek and Latin words; if to express multiplication of the original unity, Greek is used, if to express division of the original unity, Latin, or words slightly modified from the Latin, are used. The Greek words are *deca*, for ten, *hecto*, a hundred, *kilo*, a thousand, and *myria*, ten thousand. The Latin words are *deci*, for ten, *cent*, a hundred, and *mille*, a thousand. These various words are placed before, or prefixed to, the principal unity. Thus, the *decametre* is equal to ten metres, and the *decimetre* is the tenth part of a metre. The *hectolitre* is equal to one hundred litres, and the *centilitre* is the one hundredth part of a litre; the *kilogramme* is equal to a thousand grammes, and a *millegramme* is a thousandth part of a gramme. The connection between these weights and measures will now be clearly seen. The *are* is the square decametre, the *litre* is the cubic decametre, and the *kilogramme* is the weight of a litre of pure water at its maximum density.

MEASURES OF LENGTH.

	In English inches.	In feet = 12 inches.	In yards = 3 feet.	In miles = 1760 yards.
Millimetre =	0.03937	0.00328	0.00109	—
Centimetre =	0.39371	0.03280	0.01093	—
Decimetre =	3.93703	0.32808	0.10936	0.00006
Metre =	39.37079	3.28089	1.09363	0.00062
Decametre =	393.70790	32.80899	10.93633	0.00621
Hectometre =	3937.07900	328.08992	109.36331	0.06213
Kilometre =	39370.79000	3280.89920	1093.63310	0.62138

MEASURES OF CAPACITY.

	In cubic inches.	In pints = 1728 cubic inches.	In gallons = 8 pints = 277.274 cubic inches.	In bushels = 8 gallons = 2,218.192 cubic inches.
Millilitre, or cubic centimetre	0.06102	0.00003	—	—
Centilitre, or 10 cubic centimetres	0.61027	0.00035	—	—
Decilitre, or 100 cubic centimetres	6.10271	0.00353	0.02200	0.00275
Litre, or cubic decimetre	61.02711	0.03531	0.22009	0.02751
Decalitre, or centistere	610.27112	0.35316	2.20096	0.27512
Hectolitre, or decistere	6102.71120	3.53166	22.00963	2.75121
Kilolitre, or stere, or cubic metre	61027.11200	35.31661	220.09637	27.51210

MEASURES OF WEIGHT.

	In English grains.	In Troy pounds = 5760 grains.	In Avoirdupois pounds = 7000 grains.	In cwt. = 112 lbs. = 784000 grains.
0.1 milligramme	0.00154	—	—	—
Milligramme	0.01543	—	—	—
Centigramme	0.15434	0.00002	—	—
Decigramme	1.54340	0.00026	0.00022	—
Gramme	15.43400	0.00267	0.00220	0.00001
Decagramme	154.34000	0.02679	0.02204	0.00019
Hectogramme	1543.40000	0.26795	0.22043	0.00196
Kilogramme	15434.00000	2.67951	2.20435	0.01963

METEOROLOGICAL TABLES.

TABLE FOR BIDEFORD, ME. LAT. 43° 31' N., LONG. 70° 26' W. BAROMETER 40.75 +
HIGH-WATER-MARK. BY JAMES G. GARLAND.

Date.	Barometer.				Attached Thermometer.				Detached Thermometer.			
	Sunrise.	1½ P. M.	Sunset.	Mean.	Sunrise.	1½ P. M.	Sunset.	Mean.	Sunrise.	1½ P. M.	Sunset.	Mean.
1850.	Inch.	Inch.	Inch.	Inch.	°	°	°	°	°	°	°	°
Jan.,	29.950	29.974	29.963	29.962	16.590	30.85	27.70	25.046	16.98	30.83	27.81	25.206
Feb.,	29.848	29.857	29.880	29.862	19.708	35.08	31.25	28.679	20.70	36.52	32.60	29.940
March,	29.770	29.780	29.780	29.776	25.96	39.46	33.81	33.743	26.67	40.45	34.28	33.800
April,	29.906	29.834	29.897	29.912	35.52	49.88	47.16	44.186	31.32	50.45	49.98	43.916
May,	29.883	29.860	29.895	29.879	44.41	58.81	52.78	52.000	43.74	59.81	51.07	51.540
June,	30.025	30.039	30.021	30.028	57.91	77.66	70.95	68.840	58.82	80.27	70.14	69.576
July,	30.070	30.060	30.041	30.057	60.24	76.34	72.416	69.656	64.44	82.166	71.833	72.813
Aug.,	29.984	30.026	30.012	30.007	59.37	77.43	70.24	69.010	64.20	79.81	73.10	72.37
Sept.,	30.065	30.100	30.076	30.080	54.28	69.36	64.33	62.05	54.54	69.16	62.19	61.96
Oct.,	29.970	29.997	29.980	29.982	45.33	68.70	58.36	52.46	41.80	68.40	50.50	50.20
Nov.,	30.020	30.040	30.040	30.030	35.80	46.42	43.80	42.00	32.12	43.75	38.66	38.17
Dec.,	29.970	29.950	29.960	29.906	19.68	31.56	28.18	26.47	14.91	27.62	22.74	21.72
Mean,	29.955	29.969	29.963	29.962	39.566	54.295	49.927	47.896	39.137	54.936	48.742	47.600

CLIMATE OF BOSTON AND ITS VICINITY.

The *Boston Traveller* for March 28 contains a very elaborate communication on meteorological subjects, understood to be from the pen of R. T. Paine, Esq., who is well known as a diligent and accurate observer. The following are extracts from his paper.

Temperature in 1849, at Boston, Amherst, and Cambridge, Mass., and Greenwich, England.

The mean temperature of each month in 1849, in Boston (lat. $42^{\circ} 21'$), at the observatories at Amherst and Cambridge, Mass., and at that of Greenwich, were as follows:—Amherst and Cambridge being situated about 75 and 4 miles westerly from us, in latitudes exceeding our own by 1 and 2 minutes only; but that of Greenwich ($51^{\circ} 29'$) is more than nine degrees greater.

	Jan.	Feb.	Mar.	Apr.	May.	June.	
Boston,	24.62	22.89	33.22	45.39	53.65	67.57	
Amherst,	20.02	18.50	35.37	43.49	53.42	66.88	
Cambridge,	21.05	18.20	35.80	43.50	53.00	67.60	
Greenwich,	40.10	43.2	42.5	43.2	54.0	57.9	
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Boston,	71.10	69.32	62.17	51.27	47.60	31.67	48.93
Amherst,	72.09	68.85	60.05	47.03	44.08	28.40	46.65
Cambridge,	71.60	69.20	60.00	49.20	45.00	28.90	47.04
Greenwich,	62.1	62.9	58.8	51.1	44.1	39.1	49.92

The quantity of rain, including melted snow, was as follows, in inches:—

	Jan.	Feb.	Mar.	Apr.	May.	June.	
Amherst,	0.99	0.99	4.21	2.24	3.61	1.53	
Cambridge,	0.72	1.46	6.90	1.24	2.76	1.37	
Greenwich,	1.59	2.20	0.45	2.20	3.90	0.20	
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Amherst,	2.25	7.86	1.40	6.36	3.65	3.36	48.45
Cambridge,	1.17	6.52	2.13	7.56	5.43	3.78	41.04
Greenwich,	2.90	0.45	3.30	2.70	1.55	2.4C	23.84

The quantity of snow in each month was, in inches, at

	Jan.	Feb.	Mar.	Apr.	Dec.	Year.
Boston,	0.5	8.5	1.0	0.2	4.0	14.2
Amherst,	3.0	13.0	10.0	2.5	14.0	42.5

	Boston.	Amherst.	Cambridge.	Greenwich.
Thermometer highest, July 13, 96 $\frac{1}{2}^{\circ}$	July 13, 96 $\frac{1}{2}^{\circ}$	July 13, 93 $\frac{1}{2}^{\circ}$	July 13, 98 $\frac{1}{2}^{\circ}$	July, 84.1 $^{\circ}$
“ lowest, Jan. 11, —1 $\frac{1}{4}$	Jan. 11, —1 $\frac{1}{4}$	Feb. 20, —10	Feb. 20, —7	Dec. 28, 18.8
Range in 1849,	97 $\frac{3}{4}$	103	105	65 $\frac{1}{4}$

At Boston, on June 22, thermometer $95\frac{1}{2}^{\circ}$; at Philadelphia, 102° ; and above 90° for nine hours in Brooklyn, N. Y.

At the celebrated Franconia (lat. $44^{\circ} 10'$), at the foot of, and surrounded by, the White Mountains, the thermometer rose on July 13 to 102° , or about 140° higher than on the 6th of February following.

In Boston, on the 20th of February, 1849 (the coldest morning at Cambridge), the thermometer stood at $0\frac{1}{4}$; and at Cambridge, on Jan. 11, —4 $\frac{1}{4}$.

	Boston.	Greenwich.
In 1849, — barometer highest, Feb. 27–28,	30.90	Feb. 11, 30.91
“ “ lowest, Dec. 23,	29.02	Sept. 12, 29.07
Range,	1.88	1.84

The altitude of the barometer at Greenwich, on Feb. 11, was as high as has been observed there within the last 71 years. “In Dec., 1778, the reduced reading was 30.90.” Moreover, “the average reading at Greenwich from the 1st till the 18th of February was 30.55; or fully half an inch above its average value.” In Boston, this very great addition to the usual weight of the atmosphere began on Feb. 18, the day it ended at Greenwich, and continued also 17 days, till the 7th of March; the mean reduced altitude of the barome-

In the nine years the barometer was :—

Boston.			Greenwich.		
Highest,	April 2, 1844,	30.92	Feb. 11, 1849,	30.91	
Lowest,	Nov. 25, 1846,	28.47	Jan. 13, 1843,	28.20	
Range,		2.45			2.71

By the above tables it appears that, although the latitude of Greenwich is 9° north of Boston, its mean annual temperature is *exactly the same*, and 2° higher than that of our suburb of Cambridge. Moreover, that January and February are at Greenwich about 10° warmer, and July and August about as much colder, than here. The great difference between the climate of Old and New England becomes the more apparent, when it is considered that places on the *eastern* side of North America, in the latitude of $51\frac{1}{2}^{\circ}$, are nearly uninhabitable; and that in the vicinity of Quebec (lat. $46^{\circ} 49'$), or more than $4\frac{1}{2}^{\circ}$ south of Greenwich, the spirit thermometer on the 6th of February last, as it is said, sank to -52° , of 13° below the point of congelation of mercury!

It also appears that the mean annual temperature in Boston is more than 2° higher than that of the hill in Cambridge on which the Observatory is situated. This difference, it is believed, is usually found between cities and the more open country in their vicinity. It is caused, probably, in part, by the numerous fires in the city, but principally by the diminished radiation. The difference is much greater during the night than in the day; as at sunrise, between Boston and the Observatory, it is, on the average, 4° (about 6° on lower and more level situations); and at 2 P. M. nearly disappears. It, moreover, greatly varies; being largest in perfectly clear and calm mornings, much less in those that are windy, and very small in those that are rainy with strong breezes from the S. or S. W. The greatest difference occurred on January 5, 1841, viz. $15\frac{1}{2}^{\circ}$; the thermometer standing at sunrise at Cambridge, at -15° ; in Boston, $0\frac{1}{2}^{\circ}$; but 15° has been noticed several times. In consequence of this higher temperature during the night in the city, the quantity of snow is here much less than at places only a very few miles west of us; the last frost of spring is a month earlier, and the first frost of autumn a month later; and delicate kinds of grapes, pears, &c., are here well ripened, which at a very short distance fail altogether.

TABLES FOR NEWARK, N. J. LAT. $40^{\circ} 45' N.$, LONG. $74^{\circ} 10' W.$

BY WM. A. WHITEHEAD.

I.—Summary of Thermometrical Observations.

. The thermometers, self-registering, hung about nine feet from the ground, having a northern exposure, protected from rain and reflection. The monthly means are deduced from those of each day.

Months.	Maximum.		Minimum.		Highest Daily Mean.	Lowest Daily Mean.	Monthly Mean.	Daily Range.		
	Date.	Deg.	Date.	Deg.				Greatest	Least.	Mean.
January, .	27	57.75	1	13.00	49.50	19.00	34.444	23.00	1.00	11.39
February, .	27	63.00	5	10.00	50.50	17.37	35.232	30.75	2.75	13.62
March, .	14	71.00	4	9.75	63.75	19.88	38.193	28.50	2.25	14.02
April, .	30	74.00	15	24.25	62.50	34.62	47.745	32.00	8.00	20.73
May, .	28	86.75	3	37.75	73.75	49.33	57.020	32.50	3.00	18.69
June, .	20	93.00	2	46.25	82.63	55.50	71.092	29.25	9.50	21.10
July, .	25	93.50	12	55.50	83.87	67.00	75.399	28.75	3.00	17.86
August, .	6	92.00	18	53.00	80.88	64.50	72.333	25.25	1.75	17.82
September, .	6	85.75	30	42.00	78.75	53.37	65.725	23.50	1.00	17.40
October, .	5	74.75	30	32.00	65.25	47.25	56.214	33.25	6.75	18.70
November, .	27	67.50	23	25.75	57.50	32.75	47.016	33.25	2.75	15.72
December, .	1	56.75	25	11.00	45.62	20.00	33.793	24.75	2.00	12.01
Yearly Means,	Max.	93.50	Min.	9.75	66.21	40.05	52.855	29.15	3.65	16.59

II.—Summary of Barometrical Observations, and State of the Weather.

. Barometer, one of Troughton's, with an adjustable cistern. The surface of Rain-gauge four feet from the ground. The number of Fair Days derived from the addition of half-days, the general character of each A. M. and P. M. being recorded. Days of Rain, those on which it fell in appreciable quantities. Days of Snow, those on which it fell without regard to quantity.

Months.	Means, 7½ A.M.		Means, 5 P.M.		Fair Days.	Rainy Days.	Snowy Days.	Inches of Rain and Melted Snow.	Prevailing Winds.
	Attach'd Therm.	Pressure.	Attach'd Therm.	Pressure.					
	°	Inch.	°	Inch.					
January, .	Imper	fect	Observa	tions.	14	10	6	5.010	N. W.
February, .	39.73	29.97	44.52	30.11	20	5	3	3.055	S. W. to N. W.
March, .	44.93	29.97	50.32	29.96	20	8	8	4.175	N. W.
April, .	63.61	30.01	65.16	30.00	17	10	2	3.030	N. W. to S. W.
May, .	67.64	29.99	69.00	29.97	15	16	—	7.435	Variable.
June, .	73.95	30.08	75.04	30.04	20	7	—	3.535	S. W.
July, .	76.88	30.07	78.35	30.05	21	9	—	7.420	S. E. to E.
August, .	73.95	30.03	76.20	30.03	24	9	—	4.725	N. W. to S. W.
September, .	69.90	30.10	60.67	30.08	22	5	—	4.405	N. W.
October, .	66.48	30.04	66.88	30.42	23	6	—	1.725	N. W. to S. W.
November, .	63.90	30.01	66.14	30.04	16	6	—	1.520	N. W. to S. W.
December, .	60.98	30.07	62.48	30.06	12	8	9	5.110	N. W. to S. W.
Yearly Results,	63.81	30.03	64.98	30.07	224	97	28	51.145	

III. — Comparative Table.

Showing the temperature of the seasons in different years, with the quantity of water falling in rain and melted snow.

Seasons.	1844.	1845.	1846.	1847.	1848.	1849.	1850.	Means.
Winter Months,	29.88	30.42	29.96	32.44	34.54	28.14	34.49	31.41
Spring Months,	52.30	49.83	50.65	43.54	48.74	47.65	47.65	48.62
Summer Months,	70.47	72.09	70.36	70.13	70.59	72.05	72.96	71.23
Autumn Months,	52.17	53.14	55.68	53.21	51.13	55.72	56.32	53.91
Mean of Year,	51.21	51.37	51.66	49.83	51.25	50.89	52.85	51.29
Quantity of Water,	40.21	36.47	51.57	54.84	36.90	40.05	51.15	44.46

TABLE FOR SOMERVILLE, ST. LAWRENCE CO., N. Y. LAT. 44° 10' 36" N., LONG. 75° 25' 24" (ESTIMATED). ALTITUDE 412 FEET ABOVE TIDE (ESTIMATED). BY F. B. HOUGH, M. D.

Months.	Monthly Means of Thermometer.					Greatest Heat.	Greatest Cold.	Range.
	Sunrise.	9 A. M.	3 P. M.	9 P. M.	Mean.			
January, .	18.46	22.78	30.17	23.17	23.645	°	—° 8	° 52
February, .	17.18	21.82	30.53	22.25	22.945	44	—22	63
March, .	26.22	29.12	38.58	28.25	30.542	58	1	57
April, .	33.75	40.20	50.56	43.60	42.030	76	19	55
May, .	43.32	51.19	61.35	50.83	51.677	84	32	52
June, .	52.06	69.28	80.63	65.83	68.687	94	46	48
July, .	65.16	73.93	81.03	69.80	73.231	95	50	45
August, .	59.80	69.45	76.00	65.26	68.113	92	46	46
September, .	57.43	61.66	67.46	59.23	60.533	90	30	60
October, .	41.71	48.71	54.84	44.71	47.193	78	25	53
November, .	34.66	40.33	33.66	40.03	37.174	73	15	58
December, .	12.93	17.87	19.48	15.32	16.171	38	—31	69
Mean for the Year,	33.07	45.52	52.02	45.53	45.161	95	—31	126

TABLES FOR THE UNIVERSITY OF NORTH CAROLINA, AT CHAPEL HILL. LAT. $35^{\circ} 54' 21''$ N., LONG. $79^{\circ} 17' 30''$ W. BY JAMES PHILLIPS, PROF. MATHEMATICS AND NAT. PHILOSOPHY.

1850. Months.	Barometer.			Attached Therm.				Detached Therm.				Monthly Mean Tempera- ture.
	Sunrise.	3 P. M.	9 P. M.	Sunrise.	9 A. M.	3 P. M.	9 P. M.	Sunrise.	9 A. M.	3 P. M.	9 P. M.	
	Inch.	Inch.	Inch.	°	°	°	°	°	°	°	°	°
January,	29.740	29.746	29.748	42.37	46.63	54.42	48.08	39.48	44.97	52.02	44.35	45.2056
February,	.694	.683	.685	38.89	46.46	54.93	46.27	35.00	43.21	51.48	42.54	40.0580
March,	.624	.638	.656	44.65	50.87	59.58	50.47	41.44	48.37	56.63	47.43	48.4677
April,	.654	.647	.658	51.28	57.72	64.67	57.45	48.73	55.78	61.70	54.60	55.2042
May,	.629	.624	.623	59.42	65.82	75.74	64.92	56.84	64.02	72.35	62.11	63.8306
June,	.785	.784	.777	67.36	76.60	84.40	73.40	66.37	73.33	82.33	71.50	73.3333
July,	.681	.679	.691	73.52	79.84	87.81	78.44	72.52	79.28	85.61	76.74	78.5403
August,	.664	.678	.678	71.93	78.48	87.16	76.94	70.10	77.48	84.94	75.10	76.9032
September,	.652	.674	.667	66.06	71.82	78.72	71.13	64.05	70.55	77.10	68.63	70.0833
October,	.656	.662	.662	52.32	60.73	71.95	60.26	48.47	58.97	69.98	57.37	58.6976
November,	.676	.656	.686	47.58	52.40	64.03	54.16	43.96	50.36	61.80	51.70	51.9583
December,	.640	.653	.643	42.66	47.74	55.24	47.46	38.71	45.32	52.22	44.72	45.2425
Ann. Mean	29.675	29.679	29.681	54.83	61.26	69.89	60.75	52.14	59.30	67.35	58.07	58.9645

Hottest day, 1st of August:—

Barometer, at sunrise, 29.760 in.; at 3 P. M. 29.794 in.; at 9 P. M. 29.794 in.

Therm. att. " 78° " 97° " 85°

Coldest day, 5th of February:—

Barometer, at sunrise, 30.114 in.; at 3 P. M. 30.244 in.; at 9 P. M. 30.263 in.

Therm. att. " 20° " 39° " 31°

SUMMARY OF THE METEOROLOGICAL OBSERVATIONS MADE AT THE NATIONAL OBSERVATORY, WASHINGTON, D. C. NORTH LAT. $38^{\circ} 53' 39'' 25'''$, LONG. W. OF GREENWICH $77^{\circ} 03' 30''$. BY LIEUT. M. F. MAURY.

1850. Months.	Means of the Barometer.					Means of External Therm.			
	9 A. M.	3 P. M.	9 P. M.	Range.	Monthly Mean.	9 A. M.	3 P. M.	9 P. M.	Monthly Mean.
	Inch.	Inch.	Inch.		Inch.	°	°	°	°
January,	30.122	30.168	30.134	0.046	30.141	35.2	41.0	39.9	35.4
February,	30.039	29.975	30.028	0.053	30.014	35.9	44.8	37.6	39.5
March,	29.968	29.906	29.933	0.062	29.936	40.6	47.1	40.1	42.6
April,	29.990	29.935	29.989	0.055	29.971	49.6	55.2	49.0	51.3
May,	29.934	29.825	29.843	0.109	29.867	66.9	69.3	67.8	68.3
June,	30.092	30.048	30.056	0.044	30.065	75.5	79.2	76.7	77.1
July,	30.025	29.471	29.994	0.554	29.830	84.3	83.3	81.1	82.9
August,	29.631	29.597	29.975	0.378	29.734	76.3	80.3	78.2	71.6
September,	30.074	30.025	30.012	0.062	30.037	69.2	74.3	71.7	71.7
October,	30.062	30.022	30.024	0.040	30.036	57.7	63.3	58.7	59.9
November,	30.098	30.053	30.066	0.045	30.072	46.7	54.0	43.8	48.2
December,	30.061	29.523	29.321	0.740	29.968	36.6	40.9	39.8	39.1
Annual Mean, . .	30.008	29.879	29.964	0.182	29.972	56.2	61.0	57.3	57.3

ABSTRACT OF A METEOROLOGICAL JOURNAL, KEPT AT MARIETTA, OHIO, FOR THE YEAR 1850. LAT. 39° 25' N., LONG. 4° 28' WEST OF WASHINGTON CITY. BY S. P. HILDRETH, M. D

Months.	Thermometer.			Fair Days.	Cloudy Days.	Rain and Melted Snow, in Inches.	Prevailing Winds.	Barometer.		
	Mean Temperature.	Maximum.	Minimum.					Maximum.	Minimum.	Range.
January,	29.13	58	1	13	18	5.25	S. W. & S. E.	29.80	28.85	.95
February,	34.33	44	2	12	16	3.41	S. S. W. & N.	29.90	28.50	1.40
March,	39.11	66	9	13	18	4.50	S. E., S., & N.	29.70	28.65	1.05
April,	48.11	80	22	16	14	3.17	N., S., & S. E.	29.70	28.65	1.05
May,	55.81	86	32	23	8	3.25	S. W. & N.	29.60	28.98	.62
June,	69.27	88	39	26	4	4.84	S. W. & N.	29.70	29.25	.45
July,	76.14	92	60	27	4	4.41	S. & S. E.	29.45	29.25	.20
August,	71.77	89	50	23	8	6.91	S. & N.	29.60	29.20	.40
September,	63.33	84	40	26	4	4.66	S. & N.	29.64	29.10	.54
October,	51.48	81	27	22	8	2.54	S. W. & W.	29.60	29.10	.50
November,	44.68	75	18	18	12	2.42	S. S. W. & N.	29.60	29.15	.45
December,	34.66	65	10	14	17	7.00	S. W. & W.	29.75	28.45	1.30
Mean for Year,	51.48			233	132	52.36				

The mean temperature is over half a degree below that of 1849. The cause of this inequality is found in the low grade of the spring and autumnal months; the mean of the spring being nearly five degrees less than that of 1849, while autumn is about one degree less. The summer was warmer by nearly one degree and a half. The greatest heat was in July; the mean of the month being 76.14 degrees, while July, 1849, was 72.20 degrees.

In 1849, the Peach was in flower on the 7th of April; Imperial Gage and Morillo Cherry on the 11th; Pear, on the 12th; and the Apple on the 27th. In 1850, the order was thus: Peach, April 22d; Gage and Cherry, the 23d; Pear, the 27th; and Apple, the 2d of May.

The amount of rain and melted snow is 9.18 inches more than in 1849, when it was 43.18 inches, and is above the average for this climate, eight or nine inches. Crops of all kinds were abundant in Southern Ohio, fruits as well as grain.

MEAN ANNUAL DEPTH OF RAIN IN THE UNITED STATES.

Places.	Inches.	Places.	Inches.
Fort Constitution, N. H., . . .	28.85	Fort Smith, Ark., . . .	35.64
Watertown Arsenal, Mass., . . .	39.69	" Gibson, Ark., . . .	30.64
Fort Hamilton, N. Y., . . .	45.71	" Towson, Ark., . . .	46.73
Hancock Barracks, N. Y., . . .	36.92	New Orleans Barracks, La., . . .	51.85
Watervliet Arsenal, N. Y., . . .	34.22	Fort Wood, La., . . .	47.90
West Point, N. Y., . . .	48.70	Key West, Fla., . . .	31.39
Alleghany Arsenal, Pa., . . .	28.14	Charleston, S. C., . . .	33.89
Dearbornville Arsenal, Mich., . . .	31.30	Fort Monroe, Va., . . .	52.53
Fort Brady, Mich., . . .	31.89	" McHenry, Va., . . .	40.80
" Howard, Mich., . . .	33.83	Washington, D. C., . . .	34.62
" Winnebago, Mich., . . .	31.88	Baltimore, Md., . . .	39.90
" Snelling, Min., . . .	30.32	Boston, Mass., . . .	39.23
" Crawford, Wis., . . .	29.54	Hanover, N. H., . . .	38
" Leavenworth, Mo., . . .	32.68	State of New York, . . .	26
St. Louis Arsenal, Mo., . . .	24.12	State of Ohio, . . .	26

— Patent-Office Report, 1849, Part II.

INDEX

TO ARTICLES IN SCIENTIFIC JOURNALS.

Abbreviations used in the following Index.

- Acad. of Nat. Sci.*, for Journal of the Academy of Natural Sciences. Philadelphia.
Am. Ass., for Proceedings of the American Association, Charleston Meeting.
Am. Phil. Soc., for Proceedings of the American Philosophical Society. Philadelphia.
Ann. Sci. Nat., for Annales des Sciences Naturelles. Paris.
Arch. für Nat., for Archiv für Naturgeschichte. Berlin.
As. Jour., for Astronomical Journal. Cambridge.
Ath., for London Athenæum.
Brewster, for London, Edinburgh, and Dublin Philosophical Magazine.
Bul. de la Soc. d'En., for Bulletin de la Société d'Encouragement.
Chem., for London Chemist.
Chem. Gaz., for Chemical Gazette. London.
Civ. Eng. and Arch., for Civil Engineer and Architect's Journal. London.
C. R., for Comptes Rendus de l'Académie des Sciences. Paris.
Edin. Med. and Surg., for Edinburgh Medical and Surgical Journal.
Jameson, for Edinburgh New Philosophical Magazine.
Jour. of Arts, for London Journal of Arts and Sciences.
Jour. de C. et de P., for Journal de Chimie et de Physique. Paris.
Jour. of F. I., for Journal of the Franklin Institute of Philadelphia.
Jour. de Chim. Med., for Journal de Chimie Medicale.
Jour. de Pharm., for Journal de Pharmacie. Paris.
Jour. des Sav., for Journal des Savans. Paris.
Jour. Nat. Hist., for Boston Journal of Natural History.
Lit. Gaz., for Literary Gazette. London.
Mag. Nat. Hist., for Annals and Magazine of Natural History. London.
Mech. Mag., for London Mechanics' Magazine.
Min. Jour., for London Mining Journal.
Mon. In., for Moniteur Industriel. Paris.
Naut. Mag., for Nautical Magazine. London.
Phil. Trans., for Philosophical Transactions. London.
Pogg., for Poggendorff's Annalen der Chemie.
Poly. Jour., for Dingler's Polytechnische Journal.
Prac. Mech., for Glasgow Practical Mechanics' Journal.
Proc. Am. Acad., for Proceedings of the American Academy. Boston.
Proc. Nat. Hist., for Proceedings of the Boston Society of Natural History.
Roy. Soc., for Proceedings of the Royal Society. London.
Sci. Am., for Scientific American. New York.
Sill., for Silliman's Journal. New Haven.

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 Axles, railway. *Min. Jour.*, Feb.

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 Bread machine. Prac. Mech., Feb., March.
 Breakwaters, principles of their construction. Civ. Eng. and Arch., April.
 Calico-printing. Wallis. Jour. of Arts, April.
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 Cloth, machine for folding and measuring. Bul. de la Soc. d'En., Jan.
 Condensing steam-engines. Smith. Civ. Eng. and Arch., Sept.
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 Explosion of the steamboat Louisiana. Jones. Jour. of F. I., Jan.
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 Lead, white, manufacture of. Combes. Jour. of Arts, April.
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 " " revolution of the planes of polarization of radiant heat by means of. Provostaye and Desains. Pogg., No. 12, 1849.
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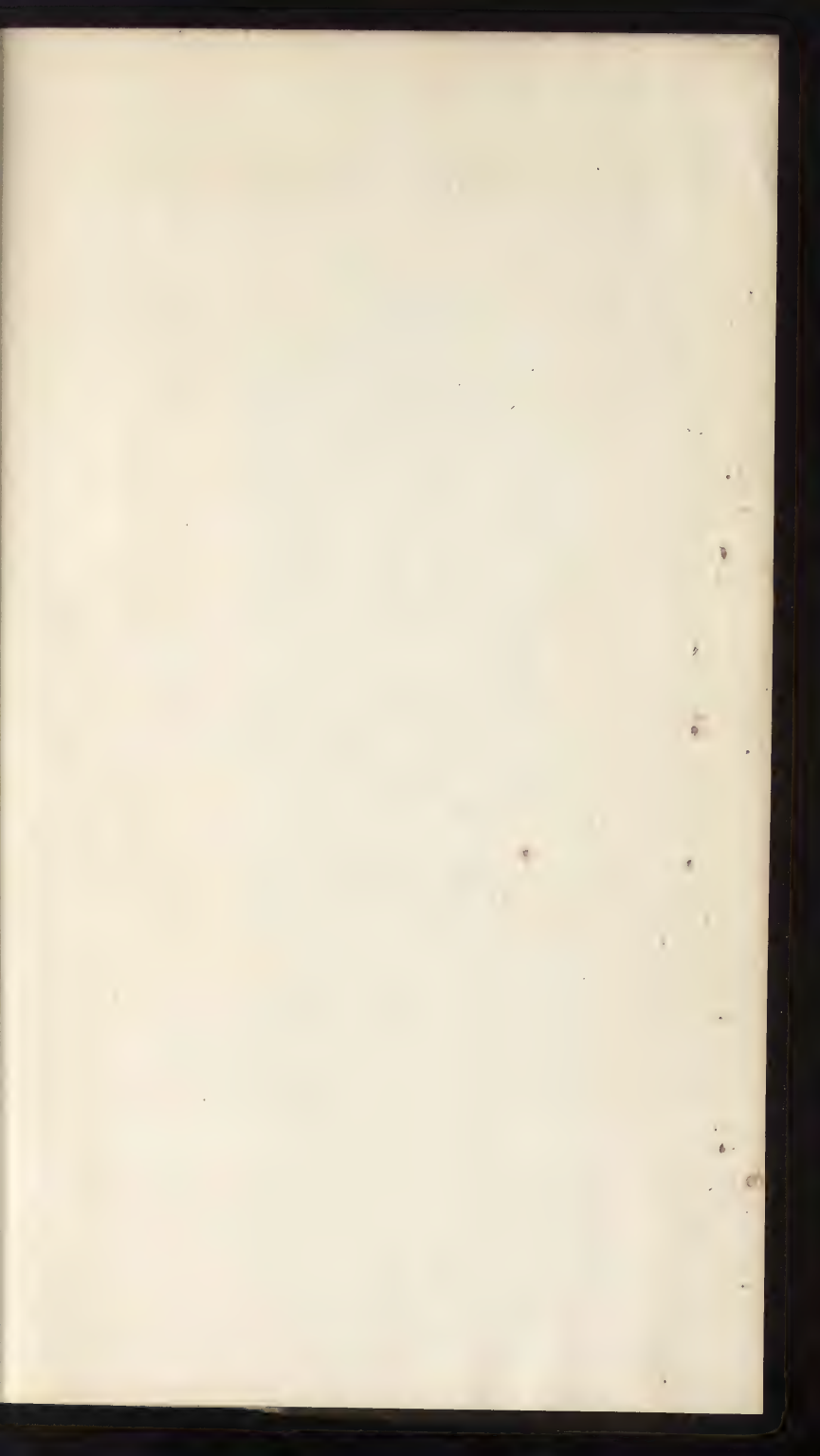
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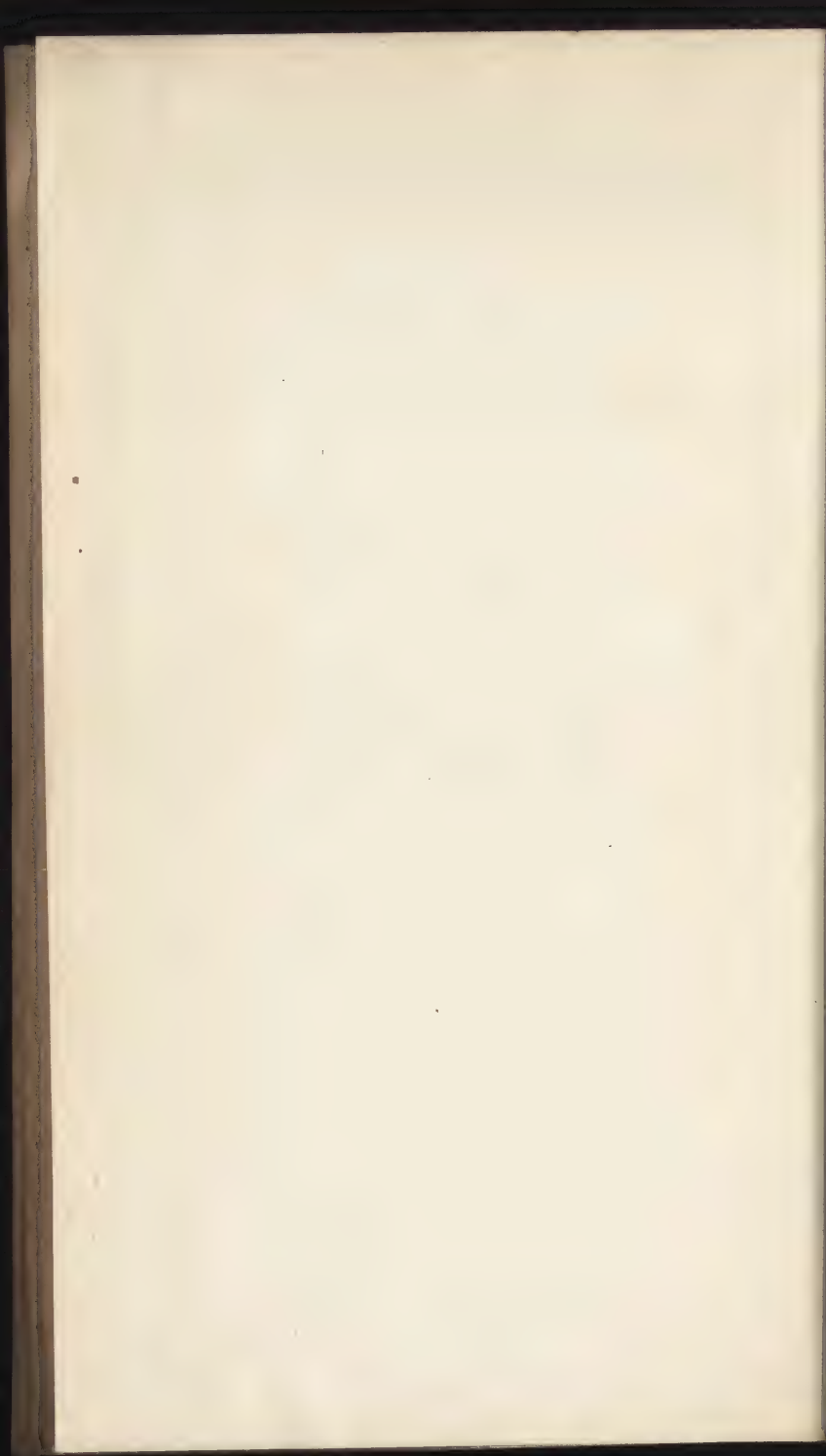
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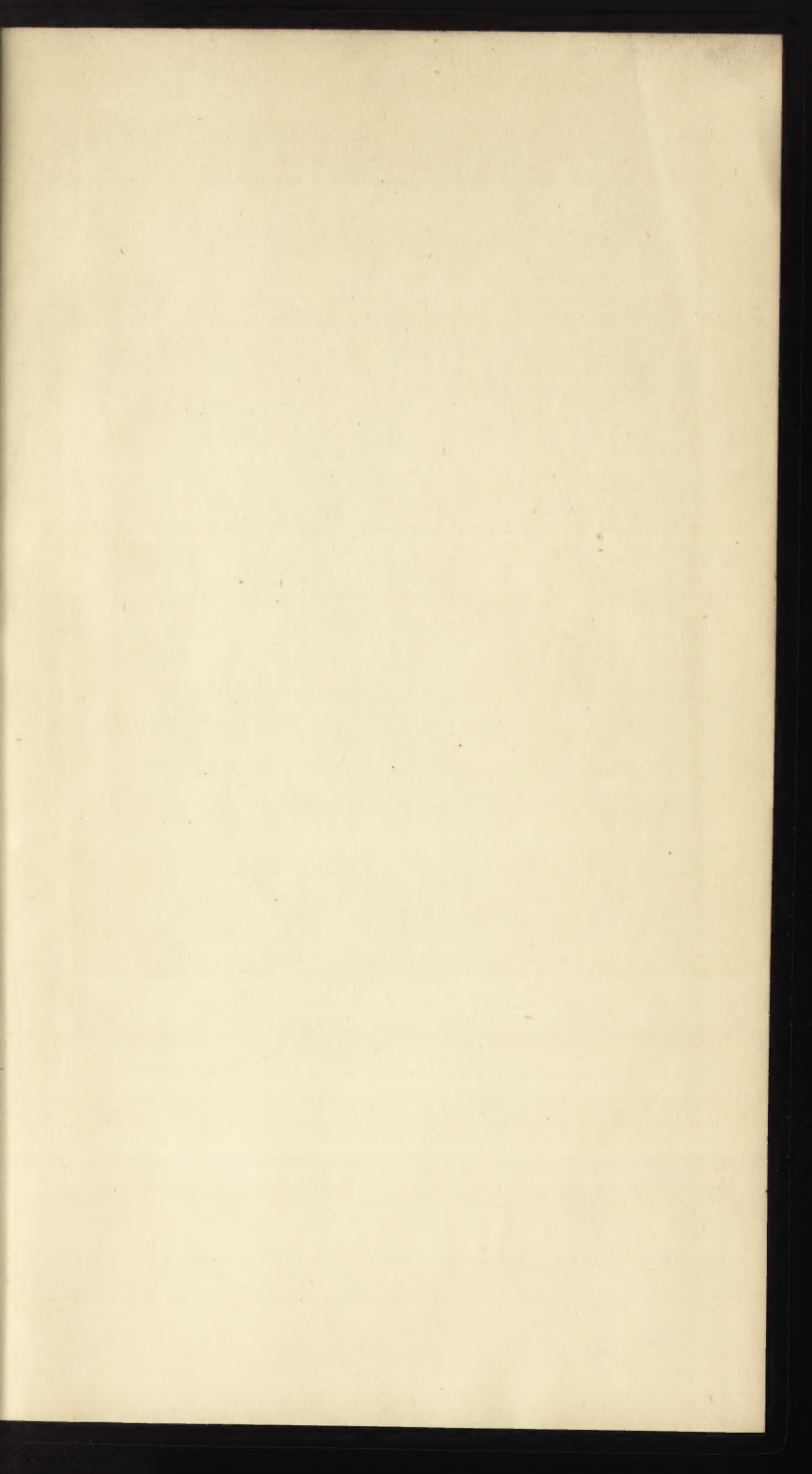
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